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HARDWARE CONCEPTS & INFORMATION PROCESSING

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Hardware Concepts

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Hardware Concepts & Information Processing

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Aptech Computer Education,
54-A, Sir M. Vasanji Road,
Andheri(E),
Bombay - 400 093.

Printed in India

1st Edition - printed in July 1995

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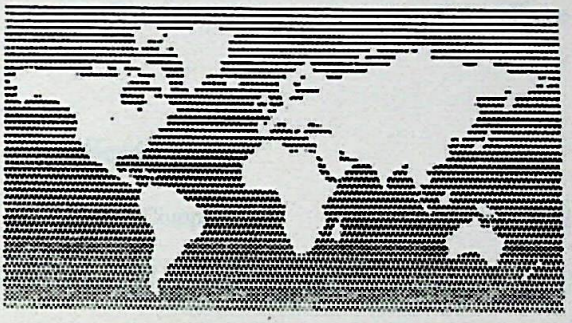
Preface



"Going on-line", "surfing on the Internet", "travelling on the information superhighway". Today these are more than just buzzwords. They are terminology's of the "information age". In this book you will be introduced to the concept of the information superhighway. The various components that go to build the information superhighway will be discussed. However, before that, we will introduce you to basic hardware concepts wherein you will learn about the hardware components of the personal computer.

In the second section you will learn about database management systems. These two chapters cover the concept of data, processing, and information.

The third section covers an introduction to the information superhighway and what it takes to go digital

The material in this book is brought to you by the Design team. The process of design has been part of the ISO 9001 Certification for Aptech - IT Division, Education Support Services. As part of Aptech's quality drive, this team is continuously researching and improving upon the curriculum to keep it in line with industry trends.

This research and development team will be glad to receive any suggestions. The students must feel free to send feedback to the Design Head at Aptech's Head Office, Bombay.

Design Team

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SECTION I

BASIC HARDWARE CONCEPTS

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Chapter 1

Basic Concept of a Personal Computer

Session Objectives :

- *Basic Structure of a Computer*
- *Communication inside a Computer*
- *Practical Structure of a Computer*
  - *Visual Display Unit*
  - *Keyboard*
  - *CPU*
- *Device Controllers*
  - *Types of Device Controllers*
- *CPU and its Properties*
  - *CPU Speed*
  - *CPU Word Size*
  - *Data Path*
  - *Memory Addressing*
- *CPU Specifications and Applications*
- *The 8088 CPU Features*
- *Internal Organization of a Microprocessor*
- *Concept of a Bus*
- *Introduction to SMPS*
- *Concept of SMPS*
  - *Switching Regulators*
- *Advantage of SMPS over Normal Power Supply*
- *Necessity of SMPS*
- *Concept of UPS*
- *Necessity of UPS*
- *Types of UPS*

1.0 Introduction

A computer is defined as a device which automatically performs logical operations on data or input and provides the output, i.e. the answers according to the performed set of instructions stored within it. Basically a computer is not intelligent by itself but it is made intelligent by humans providing the proper information and utilizing it at the maximum level. In the matter of accuracy a computer is consistently high, and it does not suffer from the human problems of tiredness and lack of concentration.

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1.1 Basic Structure Of A Computer

A computer system is made up of five fundamental units. The Central Processing Unit (CPU) includes two special units, the Control unit (CU) and the Arithmetical and Logical unit (ALU).

The ALU is the brain of a computer system because it performs almost all the mathematical and logical operations on the data. The CU functions more like a 'house master'. It decides the sequence of operations for the system.

The memory module is used to store the information. Basically two types of memories are used in computers, namely **ROM** (Read Only Memory) and **RAM** (Random Access Memory).

The two remaining units are the input module and the output module which are basically a Keyboard to provide the input to the CPU and the Visual Display Unit to visualize the result that was produced by the CPU.

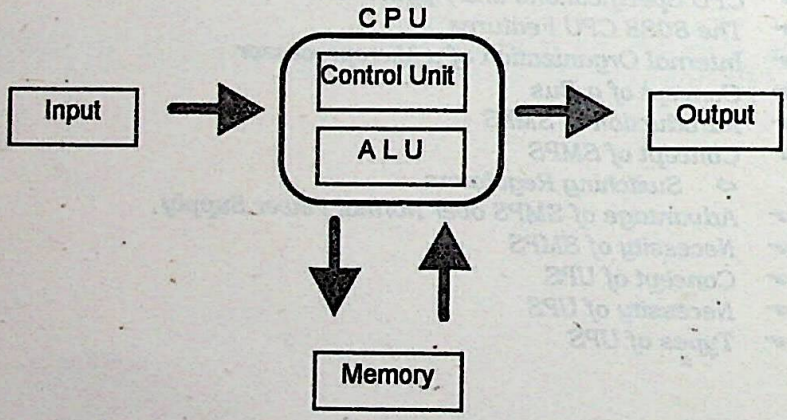

Figure 1.1

1.2 Communication Inside A Computer

As seen in the basic structure of a computer, input data is given to the control unit. The control unit analyses each instruction in the program and sends the relevant control signals to all other units, i.e. ALU, memory, input unit and output unit.

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In order to execute a program, the instructions have to be fetched from memory one by one. This fetching of instructions is done by the control unit. The control unit decodes the instruction, and issues the necessary control signals to the other units. After an instruction is executed, the result of the instruction is stored in the memory or stored temporarily in the control unit or ALU, so that it can be used by the next instruction. The results of the program are then displayed through the output unit.

The control unit and ALU are collectively known as the Central Processing Unit (CPU).

There are three main buses which the CPU uses to communicate with the peripheral devices. These are

- **Address Bus**

The address bus consists of 16, 20, 24, or more parallel signal lines. The CPU uses these lines to send the address of the memory location that is to be written to or read from. The number of memory locations that the CPU can address is determined by the number of address lines. For e.g.

CPU with 16 address lines can address 2^{16} i.e. 65,536 memory locations
CPU with 20 address lines can address 2^{20} i.e. 1,048,576 memory locations
CPU with 24 address lines can address 2^{24} i.e. 16,777,216 memory locations

When the CPU reads data from or writes data to a port, the port address is also sent on the address bus.

- **Data Bus**

The data bus consists of 8, 16, 32, or more parallel signal lines. The data buses are always indicated by double ended arrows, because they are bi-directional, which means that the CPU can read or write data from the memory or I/O (Input/Output) port through the same line. Any output devices, connected to such buses must be three state (read, write and floating) so that they can be floated when the device is not in use.

- **Control Bus**

The control bus consists of 4-10 parallel signal lines. The CPU controls the signal output to the control bus with respect to its own requirements. The typical control bus signals are

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Memory read	to read data from the memory
Memory write	to write data into the memory
Input/Output read	to read data from the input/output port
Input/Output write	to write data to the input/output port

Whenever the CPU wants to read or write data to memory or an I/O port, it has to send the address of that memory location or port and then the respective signal to communicate as required.

1.3 Practical Structure Of A Computer

1.3.1 Visual Display Unit

VDUs or Visual Display Units are basically detachable units called monitors. They are either Monochrome or Color. A standard monitor allows the system to display 25 rows of 80 characters each. There are different categories such as :

- → Monochrome display
- → Monochrome Graphics display
- → Colour Graphics display
- → Enhanced Graphics display
- → Video Graphics display
- → Professional Graphics display

All the above monitor displays have different resolutions and higher the resolution, better the display quality. The video and professional graphic displays have the highest and the best of resolutions.

1.3.2 Keyboard

It is a detachable device with 83 or 101 keys that can generate all 128 ASCII (American Standard Code for Information Interchange) characters. It can cause the machine to generate and display (or print) 256 characters, shapes or symbols. The keyboard is basically divided into three parts :

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- **Function Keys**

The Function keys are programmable. They are used to execute specific programs or to initialize special software routines. The function keys can be programmed by the software designer.

- **Numeric Keypad**

The keys on the Numeric keypad are basically used for entering digits. By disabling this function, they can be used as cursor keys also.

- **Alpha-numeric Keypad**

The Alpha-numeric keypad is basically the typewriter keypad and it contains all the characters as well as numbers and graphic symbols.

1.3.3 CPU

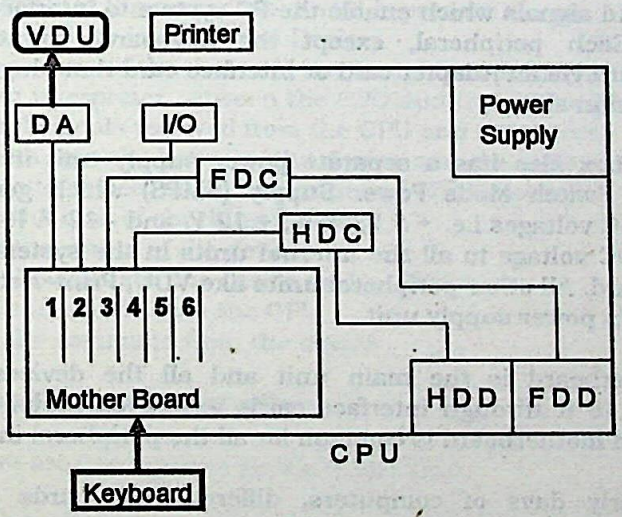

Figure 1.2

The figure above gives us a brief explanation of the contents of the CPU. The abbreviations used in the blocks are :

CPU	=	Central Processing Unit
DA	=	Display Adapter card
I/O	=	Input/Output card
HDC	=	Hard Disk Controller card

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FDC = Floppy Disk Controller card
HDD = Hard Disk Drive
FDD = Floppy Disk Drive

The most important part of a computer is the Microprocessor which lies on the system motherboard. The motherboard or system board is the densely packed printed circuit board on which the Microprocessor and its associated circuitry are mounted.

62 pins-contact expansion slots are mounted on the motherboard to connect the peripheral devices to the system. To minimize the printed wiring, common bus structures are used. There are three buses :

- → Address bus
- → Data bus
- → Control bus

The slots on the motherboard contain all these buses, as well as Power and Ground signals which enable the PC system to interface with many devices. Each peripheral, except the keyboard, connects to the motherboard via an Adapter card or interface card that plugs into one of the expansion slots.

The CPU box also has a separate power supply unit inside. This is usually a Switch Mode Power Supply (SMPS) which generates four different DC voltages i.e. *+ 5 V, - 5 V, + 12 V,* and *- 12 V.* It supplies the required DC voltage to all the internal units in the system box and to the keyboard. All other peripheral units like VDU, Printer etc. have their own built in power supply unit.

The motherboard is the main unit and all the devices which are connected to it through interface cards are called peripheral devices. The system motherboard is common for all the peripheral interfaces.

In the early days of computers, different I/O cards for different peripheral devices had to be used. For e.g.,

Hard Disk Controller card	-	Hard Disk Drive
Floppy Disk Controller card	-	Floppy Disk Drive
Input/Output card	-	Printer, Mouse etc.

But nowadays technology has improved so much, that we have almost four to five functions in one card so the number of slots used on the motherboard can be reduced. For e.g., the *Magic I/O card.* This card contains the following functions :

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- → Hard Disk Controller
- → Floppy Disk Controller
- → Game port (to connect joystick)
- → Two Serial ports
- → One Parallel port

All the above functions are included in one card and the size and consumption of current has been reduced to almost 1/4 of the original card. All the above I/O cards are also called Device Controllers.

1.4 Device Controllers

Device controllers are the devices which allow the interfacing actions between the CPU and the peripheral devices. The following are the functions of device controllers :

1. Helps the CPU to recognize the peripheral device
2. Checks whether the respective device is present or not
3. Allows the CPU to initialize the Device
4. Outputs an error if the device is not recognized properly
5. Acts as an interpreter between the CPU and the device (Interpreting the control signals received from the CPU and the device)
6. Allows data transfer between the device and the CPU or vice versa and device to device (using Interrupt and DMA modes)
7. Performs the task of checking the data
8. Analyses the status of the device
9. Provides the status of the device to the CPU
10. Receives commands from the CPU
11. Decodes the command from the device

1.4.1 Types Of Device Controllers

Basically there are two types of device controllers

- **Dumb controllers**

They are usually based on pure hardware circuits. It performs only limited functions like data transfer and command decoding.

- **Smart controllers**

They are usually based on a CPU and perform everything required to control the I/O device. A controller may either support only one device

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or multiple devices. A controller may also support more than one type of device, i.e. Printer controller supports only one Printer. A Floppy Disk controller supports four Floppy Disk Drives and a Hard Disk controller supports one or more Hard Disk Drives.

1.5 CPU and its Properties

The Central Processing Unit (CPU) controls the operations of a computer. It fetches the binary-coded instructions from the memory, decodes and identifies them and carries out the necessary actions. It contains, an Arithmetic-Logic Unit which carries out the mathematical and logical operations; an address counter which is used to hold the address of the next instruction or data to be fetched from the memory; a general purpose register, used for temporary storage of binary data and a circuitry which generates the control bus signals.

1.5.1 CPU Speed

The speed of the CPU is the number of operations that can be performed per second and directly depends on the clock rate input. The clock rate input is specified by the manufacturer and it is given in Mega Hertz (MHz).

The performance of the CPU is calculated as the number of instructions executed per second. It is normally in millions and hence specified as MIPS (Million Instructions Per Second).

1.5.2 CPU Word Size

The word size depends upon the internal architecture of the CPU (i.e. the data bus structure). For e.g. the Intel 8086 is a 16-bit microprocessor. The term 16-bit means that its Arithmetic Logic Unit, internal registers and most of its instructions are designed to work with 16-bit Binary Words. The 8086 has a 16-bit data bus so that it can read or write data to memory and ports either 16-bits or 8-bits at a time. Word size can be of 8, 16, 32, 64 bits etc.

1.5.3 Data Path

The data path consists of the number of bits that can be transported into a chip in one operation. The data path can be of 8, 16, 32, 64 etc. bits.

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In a CPU like the 8086 we can have a 16-bit data path due to a 16-bit internal and external data bus. Its advantage lies in executing an instruction of word size 16-bit, in only one bus cycle operation. But it is difficult to use the 8086 CPU with 8-bit peripheral interfaces like the timer, clock generator, DMA controller, etc. The 8088 CPU is a modified version of the 8086 but the only modification in the CPU is in its internal architecture which is of 16-bit word size but externally only of 8-bit. So it becomes compatible with all the 8-bit peripheral ICs.

1.5.4 Memory Addressing

It is the capability of the CPU to provide access to the maximum number of address locations. The CPU, 8088 has a 20-bit address line which means that it can access upto 1,048,576 bytes of information. So the addressing capacity is directly dependent on the address line. More the number of address lines more the memory addressing capacity.

1.6 CPU Specifications And Applications

The overall performance of the CPU can be improved by adding the co-processor unit to the processor (CPU). But the co-processor has to be a matching device so as to be compatible with the speed of the CPU.

Table 1.1 describes the different types of CPU, their specifications and applications. Table 1.2 gives a brief explanation of the co-processors, their speed, package type and the compatible CPU with which the co-processor can run with the maximum efficiency.

Maker	Model	Max. Speed (MHz)	Word Size (Bits)	Data Path	Memory (MB)	Computers utilizing the Chip
Intel	8088	8	16	8	1	IBM PC, XT, Portable
Intel	8088	8	16	16	1	PS/2 Model 30, Compaq Deskpro
Intel	80C86	8	16	16	1	Toshiba 1100+
Intel	80186	16	16	16	1	3Com 3 Server3, Tandy 2000
NEC	V20	10	16	8	1	Kaypro 2000
NEC	V30	10	16	16	1	NEC Multispeed, Kaypro PC
Intel	80286	20	16	16	16	IBM AT, PS/2 Model 50, 60
Intel	80386SX	25	32	16	16	Compaq 386S
Intel	80386DX	40	32	32	4096	Compaq Deskpro 386, PS/2 Model 70, 80
Intel	80486SX	25	32	32	4096	ALR 486 SX

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Intel	80486DX	50	32	32	4096	PS/2 Model 95
Intel	80486DX2	66	32	32	4096	Compaq 66M
Cyrix	80846SLC	33	33	32	16	ZEOS SLC
Cyrix	80486DLC	33	33	32	4096	ZEOS DLC
IBM	80386SLC	20	32	16	16	PS/2 Model 57SLC

Table 1.1 CPU Specifications and Applications

Chip	Maximum Speed (MHz)	Package Type	Typical CPU
8087	10	DIP	8088/8096
80287	12	DIP	80286
80387SX	25	PLCC	80386SX
80387DX	33	PGA	80386DX
80487SX	25	PGA	80486SX
80486DX	33	PGA	80486DX

Table 1.2 Co-processor Chip Information

1.7 The 8088 CPU Features

The 8088 is a high performance microprocessor implemented in a 40 pin ceramic package. The processor has attributes of both 8-bit and 16-bit microprocessor. The following are the technical features :

- → 8-bit bus interface which helps us to simplify the design of peripheral interface
- → 14 numbers of 16-bit resistor set with symmetrical operation.
- → 20-bit address line which makes it possible to address 1MB of memory
- → 16-bit internal architecture to support all internal 16-bit resisters
- → Support of up to 64K of input and output port .
- → Byte, word and block operations of data transfer to support DMA and interrupt logic
- → Supports 8-bit and 16-bit arithmetic and logic operations
- → Supports co-processor for special operations
- → Facility to allow synchronization of slow memory or I/O devices
- → Provides multiple interrupt handling and NMI support
- → It can work in minimum and maximum mode

1.8 Internal Organization of a Microprocessor

The internal organization of a microprocessor consists of two different units linked internally with each other

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- Execution Unit (EU)

The Execution Unit consists of five functional units

- → ALU
- → General Register
- → Flags
- → Scratch Pad Register
- → Control Logic

- Bus Interface Unit (BIU)

The Bus Interface Unit consists of the following

- → Instruction Queue
- → Segment Register
- → Instruction Pointer
- → Address Calculating Logic

Basic activities are divided between these two units e.g. activities like instruction fetch, operand address calculation, operand fetch and storing of the result are done by BIU, whereas instruction decoding and execution are done by EU. The BIU carries out the work related to the external bus whereas internal operations are carried out by the EU.

In a standard microprocessor, with a sequential CPU architecture the execution of a program is carried out in three steps.

- → Fetch the instruction
- → Execute the program
- → Output the result and then again fetch the next instruction

So the logic in the CPU must wait for fetching and instruction decoding before the execution begins. Therefore there is lot of overhead time waiting. This is eliminated by dividing the internal structure into two different independent units. In 8088 the BIU fetches the instruction and temporarily stores it in an instruction queue of four registers. This type of functioning is called pipeline mode. Whenever the EU fetches the instruction from the instruction queue the BIU again fills it up with the next instruction.

1.9 Concept of a Bus

Basically a bus is a path or wires through which data bits or bytes can be transferred from one place to another in a circuit. To achieve the

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maximum data transfer speed, it is necessary to use a dedicated bus between each system component but it becomes too complex in a practical circuit where more than one input/output device has to be designed to connect the system.

So microprocessors are designed and made to work with a common bus structure. Generally there are three types of buses :

- **Internal Bus**

The internal bus is used within the system board and is not available to external devices.

- **External bus**

This bus is used to interface peripheral input/output devices with the CPU and memory. There are four types of external buses

- → PC Bus
- → ISA (Industry Standard Architecture) Bus
- → EISA (Extended Industry Standard Architecture) Bus
- → MCA (Micro Channel Architecture) Bus

- **Local bus**

This type of bus is dedicated for a particular device e.g. Video Local Bus (Video Extended Standard Architecture, VESA).

1.10 Introduction to SMPS

The power supply forms one of the most essential and vital elements of any electrical or electronics equipment. It is the provider of power which actually energizes the electrical or electronic circuits and enables them to operate. It may not be in-appropriate to compare it with the role that the heart plays in the functioning of a human body.

A power system is responsible for processing the power and its conversion and translation from one form (input) into another (output). The hardware instrumental in carrying out this power processing is known as the power system.

The successful working of any piece of electrical or electronics equipment is largely dependent on the proper and reliable functioning of the power supply.

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1.11 Concept of SMPS

SMPS is an abbreviated form of Switch Mode Power Supply. As the name itself indicates Switch Mode Power Supply, wherein switching transistors are used as a switch for rapidly opening and closing the circuit to control or to regulate the output supply.

1.11.1 Switching Regulators

Basically the switching regulators consist of switching elements (switching transistors), which can be operated rapidly for opening and closing the circuit. In this way it can chop the input DC voltage at a very high frequency (15 to 20 kHz) converting it into a square wave. Once it is chopped into a square wave, it can be stepped up or stepped down by using a transformer and the voltage that is developed on the secondary end can be rectified and filtered. The regulation of the output DC voltage can be achieved by using a control circuit, in which the control senses the output voltage and if it tends to vary, it can be controlled by adjusting the data cycle (ON and OFF periods of a switching transistor) in such a way so as to counteract the changes in the output voltage.

1.12 Advantage of SMPS over Normal Power Supply

SMPS has come into widespread use in the last decade because of its high performance and compactness.

The SMPS is designed on the basis of DC-AC-DC converters, which give the maximum power efficiency, is smaller in size and less in weight due to high switching frequency which reduces the magnetic core and capacitive elements.

In the core of a normal power supply (Series Regulated Power Supply - SRPS), a huge transformer is used, depending upon the current requirement, which adds to the cost of the transformer and occupies a large space.

1.13 Necessity of SMPS

Any electronic instrument should be protected against different kinds of disturbances that may occur in your AC mains, due to various factors, that may cause damage to the sensitive electronic components which are inside the instrument. The AC mains that is received from the power station may consist of spikes, surges, frequency variation, short

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interruption and dropouts. Any one of these disturbances may affect your PC in one way or the other, causing damage to memory chips, microprocessor, hard disk, floppy drives etc. To avoid these damages, SMPS came into the picture as a part of the power supply in computers. The SPMS provides the required low-voltage, high current with a low output ripple and a very fast transient response with the help of semiconductors in a power switching circuit to control the transfer of energy from one source to the load through the use of pulse width modulation and provide all kinds of safety.

1.14 Concept of UPS

UPS is an abbreviation of Uninterrupted Power Supply. It is a combination of both electrical and electronics systems designed to provide a total continuity of AC power to a critical computerized load (eliminating all kind of disturbances) even in the absence of mains power.

A UPS draws AC power from the commercial AC line and processes it to a required condition, at the same time charging the battery which is connected to the UPS. Even if the AC mains fail, it provides an output voltage (without any interruptions) from the battery sources.

1.15 Necessity of UPS

Most of the highly sophisticated equipment like computers, medical equipment and satellite communication systems have to be run continuously without any kind of interruption. Even a short interruption may cause a serious disaster. Furthermore, with the advances in the computer technology and its vast applications in almost every corner of the world and its expansion in computer networking like LAN, WAN etc., power plays a very important role in keeping the system in working condition. The voltage that should be given for a computer system should be a pure sine wave and it should be free from all kinds of distortion.

The AC voltage that is received from the commercial line may consist of different kinds of distortion like spikes, surges, sags, brown-outs, black-outs etc.

- **Spikes**

Spikes are very high voltages which are caused due to the switching ON or switching OFF of a large electrical load.

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- **Surges**

Surges are over voltages that last for more than one cycle. They are caused due to some heavy electrical load which is suddenly switched OFF.

- **Sags**

Sags are under voltages that last for more than one cycle.

- **Brown-Outs**

Brown-outs are the low voltage conditions that can be present even for several hours. This is often created when the power demands exceed the capacity of the power supply.

- **Black-Outs**

Black-outs are nothing but no-power conditions, caused due to several factors like, short circuits, fuse blown, no voltage in the AC main etc.

- **Harmonic Distortion**

It is the deviation of the wave shape from a pure sine wave.

Frequency instability and Noise are some of the other problems which may cause havoc to the computer system.

1.16 Types of UPS

The UPS can be broadly classified into two categories.

- **Rotary type**

Rotary type is the earliest type of UPS. Nowadays this kind of UPS is replaced by the static type because of its disadvantages like huge size, lot of noise and the need for regular preventive maintenance. Even though it is outdated, this kind of UPS is used in some of the bigger computer installations. It is made up of a DC motor, fly wheel, an AC generator, a battery bank and a battery charger.

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- **Static type**

The static type of UPS is known for compactness and silent operation as they make use of electronic components (nowadays, they are also using microprocessors) thereby offering many functions. Basically it is made up of four major blocks. These are battery charger/rectifier, battery bank, inverter and transfer switch. The static type of UPS can be divided into two configurations.

⇨ **OFF line or stand-by UPS**

In OFF line UPS, the output is directly connected to the commercial AC mains via a transfer switch and at the same time the AC mains is stepped down, rectified, filtered and given for charging the battery bank. From the battery bank it is given to the inverter section and from there it is given to the transfer switch. Whenever the AC mains fails, the transfer switch switches the load to the inverter section, which is driven from the battery bank. A relay which is used in the UPS system to sense the fail of the AC mains triggers the inverter. The switch over takes at least a time of 25 to 50 mseconds. The load is capable of sensing the power interruption for that period. This is the main disadvantage of stand-by UPS or OFF line UPS (which may cause data error in the hard disk of a computer). Another main disadvantage of this kind of UPS is, under normal circumstances the AC mains is connected to the load directly, and so whatever is the problem in the AC mains (like harmonic distortion, voltage fluctuation etc.) the load has to face it during that period. However this type of UPS is cheaper, compared to the ON line UPS.

⇨ **ON line or line preferred UPS**

In the case of ON line UPS, the AC mains from the commercial line is stepped down to the voltage which is equal or slightly more than the voltage in the battery bank and then it is rectified, filtered and given to the battery bank to charge the battery and then is given to the inverter section. The output voltage from the inverter section is given to the transfer switch and then to the load. Even if the AC mains fails in the commercial line, the voltage is provided to the load from the inverter section which is driven by the battery bank, thus avoiding all kinds of distortion from the commercial line. If the problem arises due to battery bank or inverter section, suddenly the transfer switches the load to the AC commercial line within a time of 25 to 50 mseconds, thus providing a continuous voltage. In this case the transfer switch bypasses the load, until the problem in the UPS is sorted out.

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The battery is considered to be the heart of the UPS. Without the batteries the UPS cannot be considered functional. It is the battery which causes most of the problems compared to the other components, which are used in the UPS. The battery has a shorter life and due to improper selection of the battery, the life gets further shortened. Almost all the batteries that are used for the UPS are of 12 V and they are defined in terms of Amph-Hour. More the Amph-Hour, more the backup time available for the computer system. And they are all connected in series. The number of batteries required depends upon the design of the UPS. While selecting the battery it is always better to go for SMF (Sealed Maintenance Free) batteries. The life of the battery is defined in terms of cyclic life. Cyclic life is strongly influenced by the depth of discharge. Shallower the depth of discharge, higher the cyclic life. Thus for 30% discharge, life is almost 1200 cycles, while for 100% discharge it is only 250 cycles.

Summary

A computer is a device which automatically performs logical operations on data and provides output, according to the set of instructions stored within it.

The five fundamental units of a computer system are :

- Central Processing Unit (CPU)
  - Control unit (CU)
  - Arithmetical and Logical unit (ALU)
- Memory
- Input module
- Output module

CPU uses three main buses to communicate with the peripheral devices

- Address Bus
- Data Bus
- Control Bus

Two types of Device controllers

- Dumb controllers
- Smart controllers

The internal organization of a microprocessor consists of two different units linked internally with each other

- Execution Unit (EU)
- Bus Interface Unit (BIU)

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Three types of bus structures

- Internal Bus
- External Bus
- Local Bus

In Switch Mode Power Supply (SMPS), switching transistors are used as a switch for rapidly opening and closing the circuits or to regulate the power supply.

An Uninterrupted Power Supply (UPS) draws power from a commercial AC line and processes it to a required condition while charging the battery, connected to it, at the same time.

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Chapter 2

Memory Management in IBM PC

Session Objectives :

- *External Organization of Memory*
- *Types of Memory*
- *Dynamic RAM*
- *Concept of Memory Banks on 16-Bit and 32-Bit Computers*
- *Concept of Main Memory*
- *Expanded Memory*
- *Extended Memory*
- *Concept of Cache Memory*
- *Introduction to CRT display*
- *CRT Interface*
- *Composite Video*
- *Video Attributes*
- *CGA and its Functions*
- *Types of Monitors*

2.1 External Organization of Memory

All the memory, i.e. ROMs and RAMs are internally organized in the form of a matrix: i.e. Rows and Columns. Internal organizations are not visible to the circuit. Only the external organization of the memory IC is necessary for designing a memory subsystem. Any two memory ICs with similar external organization may have different internal organizations.

There are two important parameters which define external organization

- → Number of locations (number of memory bit cells)
- → Word length (width-organization of data bus)

The internal organization decides the following specifications

- → Number of address bits
- → Number of data bits
- → Write operation
- → Read operation
- → Chip selection

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2.2 Types of Memory

Figure 2.1 shows the different types of memory

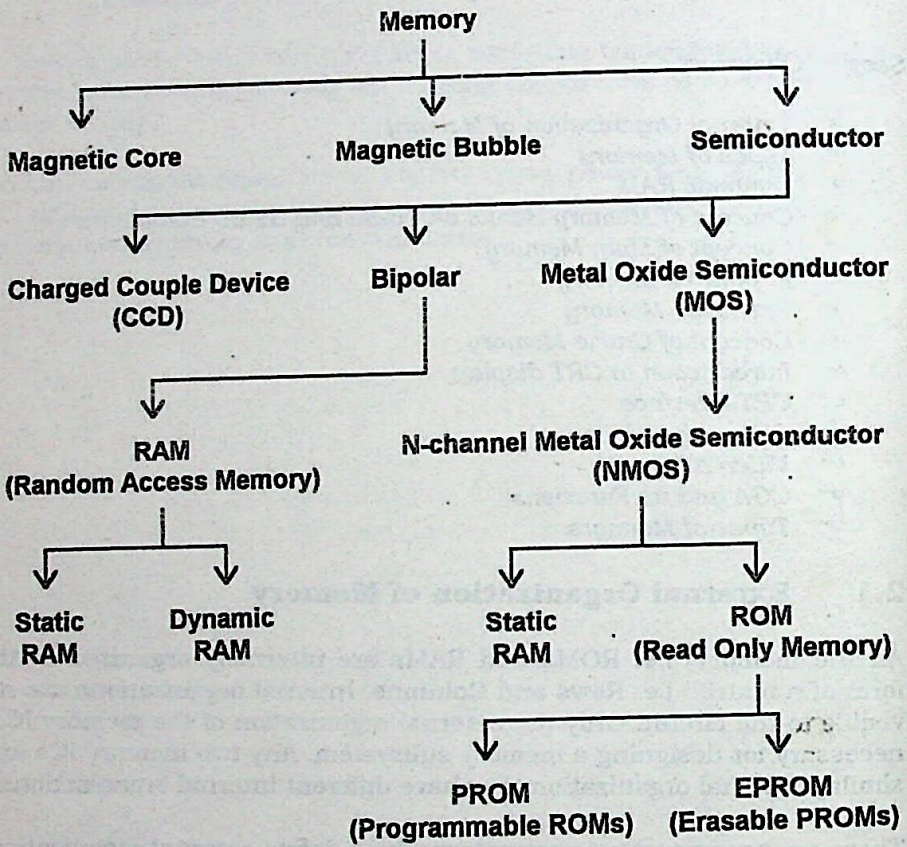

Figure 2.1

The three types of semiconductor memory chips commonly used with microprocessors are ROMs, PROMs and RAMs. Almost every microprocessor based system uses all the three types either at the development or production stage. But NMOS (N-channel Metal Oxide Semiconductor) memories are presently the cheapest and most widely used in computers. In PCs, ROMs are used to store BIOS routines. Since it is a non-volatile type, its contents do not get lost when power is switched off. RAMs are of two categories :

- → Static
- → Dynamic

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They are both volatile RAMs, and their contents are lost if the power fails. Static RAMs are used to store the CMOS configuration of an AT machine as the power consumption of the CMOS static RAM is very low and a battery can be used for backup power.

Generally static RAMs are organized as 8-bit RAMs with individual address lines to access all the memory cells organized in a RAM chip.

2.3 Dynamic RAM

The most advantageous point of a Dynamic RAM (DRAM) is its size. More number of memory cells can be integrated in a DRAM chip. But the organization of the DRAM is a bit complicated. It is organized as a 1-bit output and the address lines are multiplexed internally. It is addressed as Row Address Strobe (RAS) and Column Address Strobe (CAS) and it outputs only one data bit per RAS and CAS.

To make it clearer let us compare Static RAM and Dynamic RAM.

Static RAM (e.g. 6264)	Dynamic RAM (e.g. 4164)
The number indicates the capacity of SRAM i.e. 64K bit memory cells.	The number indicates the capacity of DRAM i.e. 64K bit memory cells.
It is organized as 8-bit SRAM so 64/8 = 8 therefore we can say it is organized as 8K x 8-bit RAM	It is organized as a 1-bit DRAM so we can say it is organized as 64K x 1-bit RAM

So we can say that the capacity of the SRAMs and DRAMs are equal since they are both 64K bits of memory cells. But the size and cost of static RAMs are much higher than DRAM. Therefore in PCs, DRAMs are used as main memory due to lesser cost and size.

Since the data buses in the PCs are of 8-bit ,16-bit or 32-bit, the DRAM has to be organized in such a manner that it fulfills the need of the PC bus.

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2.4 Concept of Memory Banks on 16-bit and 32-bit Computers

The most important fact to remember is that the BIOS and the hardware design of the PCs (XT, AT) are such that if the memory on the system board is not installed, then the display will not appear on the CRT screen even if all the components are working perfectly. Memory is an essential component on the motherboard. The minimum of one bank is required and that too at BANK 0 only and not the other banks.

As far as PCs are concerned, we need only one bank of memory to get the display on and continue with further operations because PCs have an 8-bit bus. When it comes to an AT 286 or 386SX machine, the organization is of 16-bit and hence a minimum of two banks of DRAMs are necessary to get the display on. In 386DX, 486SX and 486DX machines the bus organization is of 32-bit and so we need a minimum of 4 banks to get the display on the screen. Figure 2.2 clears the picture of memory organization in PCs , XT, AT 286 and AT 386 machines.

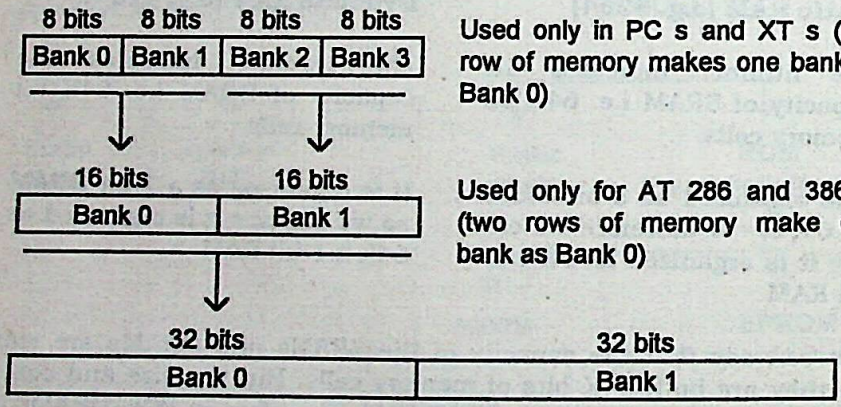
8 bits
8 bits
8 bits
8 bits
Bank 0
Bank 1
Bank 2
Bank 3
Used only in PC s and XT s (one row of memory makes one bank as Bank 0)
16 bits
16 bits
Bank 0
Bank 1
Used only for AT 286 and 386SX (two rows of memory make one bank as Bank 0)
32 bits
32 bits
Bank 0
Bank 1
Used only for 386DX and 486SX or DX (four rows of memory makes one bank as Bank 0

Figure 2.2

2.5 Concept of Main Memory

It is the memory which is actually recognized by MS-DOS as the base memory which starts right from the base address and is limited upto 640KB. Since the read mode is restricted to access only 1MB of memory, IBM had decided to keep a limit of 640KB on the main memory. As DOS

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boots up the machine, it occupies the first few locations of the base memory (main memory) for storing the DOS resident programs and the vector address of the interrupt routines. After the system boots up, the memory available within this 640KB of area is called conventional memory (the memory available for the user to execute the programs).

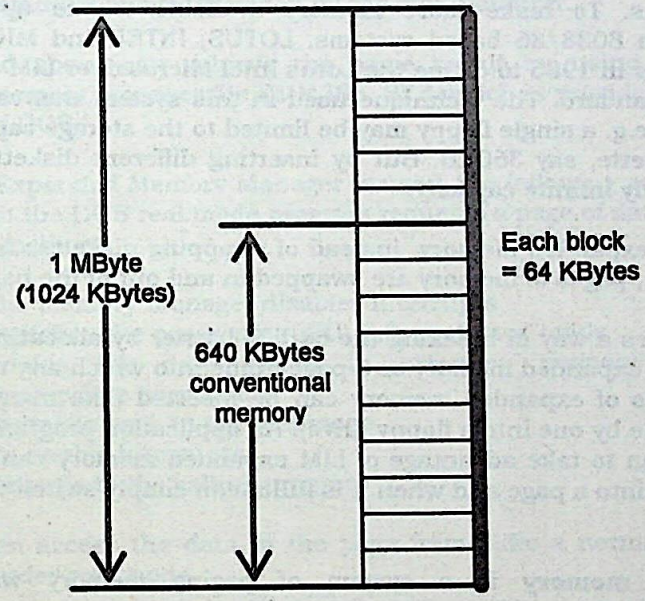

Figure 2.3

The area of memory above 640KB is often referred to as Upper Memory Area (UMA) or in other words Expanded Memory. The above 640KB upto 1MB i.e. 384KB (640K + 384K = 1024K = 1MB) of memory is reserved for special use by BIOS ROM, video and other hardware.

Some of the address space above 640KB is empty, some filled with RAMs that are used by video adapters and some are filled with ROMs that contain the low level drivers for devices such as hard disk controllers, LAN adapter, video adapter etc. The memory area which is dedicated to particular device RAMs and ROMs are called reserved memory area.

There is some more address space within the 384KB of RAM which is kept as reserved space for future use and some of the address space is allocated as buffered space that is used for the video adapter memory

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which is shared between the CPU and the CRT controller. Most of this buffered space for video is used by VGA and PGA card.

2.6 Expanded Memory

The 640KB limit to base memory becomes a problem for PC applications. To make more memory available to the applications running on 8088/86 based systems, LOTUS, INTEL and MICROSOFT got together in 1985 to define the Lotus Intel Microsoft or LIM expanded memory standard. The technique used in this system was called page swapping, e.g. a single floppy may be limited to the storage capacity of a single diskette, say 360KB. But by inserting different diskettes it has an effectively infinite capacity.

In case of expanded memory, instead of swapping diskettes in and out of the drive, pages of memory are swapped in and out of the page frame.

LIM provides a way of breaking the 640KB barrier by allocating a 64KB area in the expanded memory as a page frame into which any number of 64KB pages of expanded memory can be inserted (like many floppies inserted one by one into a floppy drive). An application program that has been written to take advantage of LIM expanded memory can read and write data into a page and when it is full it can simply switch to another page.

Expanded memory is a system of paging memory within the conventional memory by using a block of memory as a **page frame** in the expanded memory area.

A **page frame** is an area of memory map where expanded memory pages can be switched in and out.

EMS (Expanded Memory Specification) is an alternative definition of the Lotus Intel Microsoft (LIM) standard.

Expanded memory is used only by read mode programs and extended memory can be used to simulate expanded memory by using software.

2.7 Extended Memory

The memory beyond 1MB that is accessible only when the 386 is in a protected mode is generally referred to as the extended memory. This memory is inaccessible to programs that are running under DOS. To

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make use of this memory, protected mode operating systems such as OS/2 or UNIX is necessary.

One way to use extended memory is to emulate expanded memory. To do this, the 80286 needs an enhanced logic chip set which gives the hardware extra help. The A20 gate handler helps DOS access expanded memory by emulating extended memory. The machine should also run a specific memory manager provided by the manufacturer.

80386 and above can achieve the same result by using the most common memory manager file EMM386. SYS which is provided by many versions of DOS.

When an Expanded Memory Manager is used, the following actions take place when the DOS real mode program requests a page of data from the expanded memory:

- → The memory manager disables interrupts
- → Switches the processor (CPU) into protected mode
- → Copies the data stored in extended memory into the appropriate page frame
- → Switches back to the real mode
- → Re-enable interrupts
- → Returns to the calling program

Then it can access the data in the page frame like a normal machine working under real mode.

The Interrupt must be disabled while the processor changes from real mode to protected mode, since service routines in the BIOS, DOS or other user-installed programs can run only in real mode. The programs will not save the processor status correctly if an interrupt caused them to be executed in protected mode.

2.8 Concept of Cache Memory

The basic concept of cache memory is to allow a fast processor to read and write data directly without introducing a wait state. If a processor wants to access data and if the cache provides it then it is called cache hit and if the cache cannot provide the data then the processor has to access the main memory by introducing a wait state and this is called cache miss. The data accessed from the main memory is not only made available to the processor but is also stored in the cache so that the

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next time whenever the processor asks for it, the cache can provide it without introducing any wait state.

So basically cache avoids wastage of time for the CPU and gives a better performance.

Implementing cache memory as the main memory is expensive and so the typical cache sizes available with the system-boards are 16KB, 32KB, 64KB, 128KB, 256KB which are very small compared to the typical 4MB or 8MB found on the 386/486 machine.

2.9 Introduction to CRT Display

CRT (Cathod Ray Tube) Display is a typical way of displaying characters, numbers and graphics on a screen which is a matrix of pixels arranged on a phosphor coated screen which glows when an intense electron beam falls on it.

The character formed on the CRT screen is not a continuous one but a collection of dots which create a character-like pattern within a matrix of dots. The letter is formed in a 7 x 9 dot matrix within a 9 x 14 dot matrix. The size of the character box is always longer than the actual character matrix size to provide for gaps between adjacent characters in the same row or between rows and extra space for upper case characters.

The characters or numbers can be displayed by illuminating the wanted pixels and blanking the remaining pixels in a character matrix. These pixels can be illuminated by an electron beam, which scans the screen in a particular period of time to maintain the persistency of the phosphor to give a stable display. There are two types of scanning techniques used to produce images on the CRT screen.

- → Raster scan
- → Vector scan

The Raster scan is the most commonly used technique for the CRT display used in PCs. In the Raster scan technique, two types of signals are generated.

- → Horizontal deflection (to move the beam horizontally)
- → Vertical deflection (to move the beam vertically)

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These two deflection signals deflect the beam back and forth across the screen like a Raster. After scanning the whole line or a screen, a retrace period is provided which is suppressed or blanked by reducing the intensity of the electron beam. These horizontal and vertical deflection signals are also called sweep or scan and the typical sweep or scan rate for the horizontal is 15.75 kHz and for the vertical is 50 or 60 kHz.

Originally there were only two types of CRT displays used with PCs.

- → Monochrome display supports only alphanumeric text display and not graphics.
- → Color graphics display supports both text and graphics in color.

Presently there are many different types of CRT display used with PCs.

- → Enhance graphics display
- → Video graphics display
- → Professional graphics display

The major differences in these CRT displays are their resolutions and number of colors they can support.

For each different type of CRT display you need a specific display adapter so that you can utilize the maximum efficiency of the CRT Display, i.e. Color and Resolution.

In color monitors, instead of single phosphor dots, the screen is coated with a pattern of little circular or rectangular phosphor dots of three different types equally distributed on the screen. These phosphor dots red, green and blue glow when their respective electron beams fall on them. Any color is obtained by varying the intensities of the red, green and blue electron beams in definite proportion. White color can be obtained by making the intensity of red, green and blue equal.

2.10 CRT Interface

This is basically an interface device which controls the operation and performance of the CRT display by providing the following signals

- → Hsync (Horizontal sync)
- → Vsync (Vertical sync)
- → Video (Data information)

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The Vertical and Horizontal sync signals are used to synchronize the display information. The deflection signal is generated by the monitor itself.

The intensity of the electron beam is modulated by the video information to produce the illumination or blanking of dots. The blanking pulses are fed to the video input to turn off the electron beam during the retrace period of each horizontal and vertical frame scan.

2.11 Composite Video

Some monitors work on composite video signals. It is used to generate graphics as well as text on the screen, with a very low resolution. The adapter provides Hsync, Vsync and Video signals superimposed on each other as a composite signal on a single coaxial line to the monitors. The monitor has the circuitry to separate out the three signals comprising the composite video.

2.12 Video Attributes

In a PC, attributes can change with every character. The screen memory is 8 bit wide and each even location of the display memory contains ASCII characters and each odd location contains the attribute byte for the preceding ASCII character. Attributes are ways of enhancing the information displayed on the CRT screen. The basic attributes are

- **Reverse Video**

For a Monochrome Display Adapter to get the white level on the screen, logic 1 is required in the video display interface. Logic 0 is for black level. In the case of reverse video the logic of white and black levels is complemented by the MDA producing a display with black characters on a white background.

- **Underlining**

A specific scan line is used within the character box for underlining a character or a line. When this attribute is specified, the underline scan line is decoded and the video dot stream is logically Red with all 1's, producing a continuous line for the length of the character box.

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- **Blinking and Blanking**

Blinking is usually achieved by blanking and unblanking the character alternatively at a very low frequency of around 1 Hz and 3 Hz and this low frequency for blanking is derived by dividing the Vsync from the CRT controller.

- **Intensity**

Intensity is one of the output signals from the MDA and it is controlled by the intensity attribute bit. It produces bright letters on the screen when this signal is active. The MDA design provides two different intensity signals. It is specified by setting the Blink Attribute BIT and resetting EB (Enable Blink) bit. The two different intensity signals are

- → **I (B) - Intensifies the background**
- → **I (F) - Intensifies the foreground**

The CGA supports RGB monitors through a TTL interface, but the resultant color is achieved by changing the intensity proportionately for the composition of three individual signals Red, Green and Blue.

2.13 CGA and its Function

Since the MDA is a character only display, it does not have the capacity to run any software requiring graphics. This type of display is known for clarity with high resolution which is basically used for word processing and spreadsheets only, because graphics have become more and more important in any type of software.

The CGA can support color monitors with graphics capacity. The CGA provides three video interfaces

- → **Composite video output**
- → **A direct drive RGB (TTL) output**
- → **RF modulation interface for linking a home TV via an external RF modulator**

It can operate in black and white as well as the color mode. In the color mode sixteen foreground and eight background colors are possible with individual character blinking possibility. In black and white mode, three character attributes such as reverse video, blinking and intensity are available. The CGA also supports two alphanumeric (text) modes and two all points addressable graphics modes.

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The alphanumeric modes are 40 x 25 mode for low resolution or a home television and 80 x 25 mode for high resolution monitors.

The graphics modes are a medium resolution color graphics mode of 320 pixel x 200 rows and high resolution black and white graphics mode of 640 pixels x 200 rows.

2.14 Types of Monitors

Monitors can be divided into different categories depending upon the signal they use for displaying the information on the screen. They are

- **Digital Monitors**

Different types of monitors like MDA, CGA and EGA come under digital monitors. The data describing the pixel colors is sent from the video adapter to the monitor in a series of digital signals that are roughly equivalent to a series of data bits.

For video boards that can display only a limited number of colors, the digital system is practical and economical because the circuitry is less sophisticated than on an analog system.

In the case of monochrome monitors (MDA), it can display information only in black and white and it is used for display in the text mode.

Color graphic monitors (CGA) are used to display information in color and it can also be used for displaying both text and graphic information on screen.

Enhanced graphic monitor (EGA) is used for color and also for advanced graphics.

- **Analog Monitors**

The VGA monitors come under this type as they use analog signals to transfer the color information from the video adapter to the monitor. You cannot use a digital monitor on an analog display adapter or an analog monitor on a digital adapter. In the analog monitor there are two types

→ Monochrome VGA
→ Super VGA (Color VGA)

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In the case of monochrome VGA monitor, it can display information only in black and white, and the Super VGA monitor can display a wide range of colors.

Table 2.1 shows the monitor types and their compatibility with the common video adapters.

	Video Adapter			
Monitor Type	**Monochrome**	**CGA**	**EGA**	**VGA**
Digital				
Monochrome	Yes	No	No	No
CGA	No	Yes	Yes	No
EGA	No	Yes	Yes	No
Analog				
VGA	No	No	No	Yes

Table 2.1

Summary

Two categories of RAMs are
- Static
- Dynamic

If the memory is not installed on the system board, the display will not appear on the CRT screen even if all the components are working perfectly.

Main memory is the memory which is actually recognized by MS-DOS as the base memory and is limited upto 640KB.

Main Memory is also called conventional memory.

The area of memory above 640KB is referred to as Expanded Memory or Upper Memory Area

Expanded Memory is a system of paging memory within the conventional memory by using a block of memory as a page frame in the expanded memory area.

A page frame is an area of memory map where expanded memory pages can be switched in and out.

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The memory beyond 1MB that is accessible only when the 386 is in a protected mode is referred to as Extended Memory.

The basic concept of cache memory is to allow a fast processor to read or write data directly without needing to access the main memory every time.

The different types of CRT displays presently used with Pcs are

- **Enhanced Graphics Display**
- **Video Graphics Display**
- **Professional Graphics Display**

The basic video attributes are

- **Reverse Video**
- **Underlining**
- **Blinking and Blanking**
- **Intensity**

The different categories of monitors are

- **Digital monitors**
  - **Monochrome monitors (MDA)**
  - **Color Graphic monitors (CGA)**
  - **Enhanced Graphic monitors (EGA)**
- **Analog monitors**
  - **Monochrome VGA**
  - **Super VGA (Color VGA)**

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Chapter 3

Peripherals

Session Objectives :

- *Floppy Disks*
  - ⇨ *Structure of a Floppy Disk*
  - ⇨ *Floppy Disk Organization*
- *Floppy Disk Controller Overview*
- *Disk Format*
- *Floppy Disk Drive*
- *Floppy Disk Drive Functions*
- *Floppy Disk Controller Functions*
- *Software Function*
- *Basic Structure of a Hard Disk*
- *Types of Hard Disk Controllers (HDC)*
- *Working Principle of a Hard Disk Controller*
- *Parallel and Serial Ports*

3.0 Introduction

Since the ROM and RAM memory in a computer cannot hold all the programs that we might want to run and all the data that we might want to analyze, a computer system needs some other form of data storage which can hold massive amounts of data, is non-volatile, can be updated, and has relatively low cost per bit of storage.

The most common devices used for mass data storage are the magnetic tape, the floppy disk, the hard disk and the optical disk. The magnetic tapes are basically used only for keeping backup of the data as the access time to get the data stored in the middle of the tape is usually too long to be acceptable.

The floppy disk, hard disk and optical disk are acceptable for daily usage with the computer, since their access time is much faster than that of the magnetic tapes.

3.1 Floppy Disks

A floppy disk itself is made of mylar and coated with a magnetic material. The mylar disk is only a few thousands of an inch thick. Thus

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the name FLOPPY. The available sizes for floppy disks are 8 inches, 5.25 inches and 3.5 inches. A floppy disk is always enclosed in a plastic protective envelope which is also called the jacket.

3.1.1 Structure of a Floppy Disk

Basically a floppy disk consists of the following :

- **Write Protect Notch**

The write protect notch is always available on a floppy disk. The main purpose of this notch is to avoid accidental erasing of the data by the user or to protect important data stored on the floppy. If the write protect notch is covered then you cannot erase or write any data onto the disk.

- **Clamping Hole**

It is also called the drive spindle hole. When a floppy is inserted into the floppy drive, the clamping hub of the device will hold the floppy firmly and accurately from both the sides.

- **Index Hole**

The index hole is in the inner most side of the floppy before the clamping hole. The main purpose of the index hole is to indicate the ending of a sector and start of a new sector.

- **Head Slot**

It is an open window on both sides of the floppy through which the floppy drive can read or write data onto the disk.

3.1.2 Floppy Disk Organization

First let us study how a floppy diskette is organized and why it is to be organized or formatted in a typical way.

Let us take an example of a text book which has notes of 20 chapters, with each chapter having 20 different topics and each topic covering at least 2 pages. So the capacity or the notes written in the text book can be equated as

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Number of chapters x Number of topics per chapter x Pages per topic
20 x 20 x 2
= 800 pages

So the book has 800 pages. Whenever we have to access any note in that text book, we will not go through all the pages but we will open the index. Index is the most important page of a book and if that page is torn it will be very difficult for a user to refer to any topic in that book because the index contains important information like

→ Chapter numbers
→ Name of the topics described in the chapter
→ Page number on which the topic is described

That means to access any note or data from a large book, we must have an index for the book which helps us to access the notes or data quickly.

If we consider a floppy disk as a book, they are both mass storage devices but a text book is read by human eyes whereas a floppy disk is read by the machine so the format has to be different for reading and writing data onto the disk.

A floppy disk is organized as concentric circles, called tracks and each track is divided into sectors, each sector having a capacity of 512KB of data. Since the data is written on both sides of the floppy we have to calculate the capacity of a floppy disk as :

Number of HEADS or SIDES	x	Number of TRACKS	x	Number of SECTORS	x	Number of KB/SECTOR

This product will be the total capacity of the floppy diskette. So a 360 KB floppy has

2 x 40 x 9 x 512
= 368,640 Bytes
= 368 Kbytes

In the same manner if we take the parameters as

2 x 80 x 15 x 512
= 1228800 Bytes
= 1.2 Mbytes

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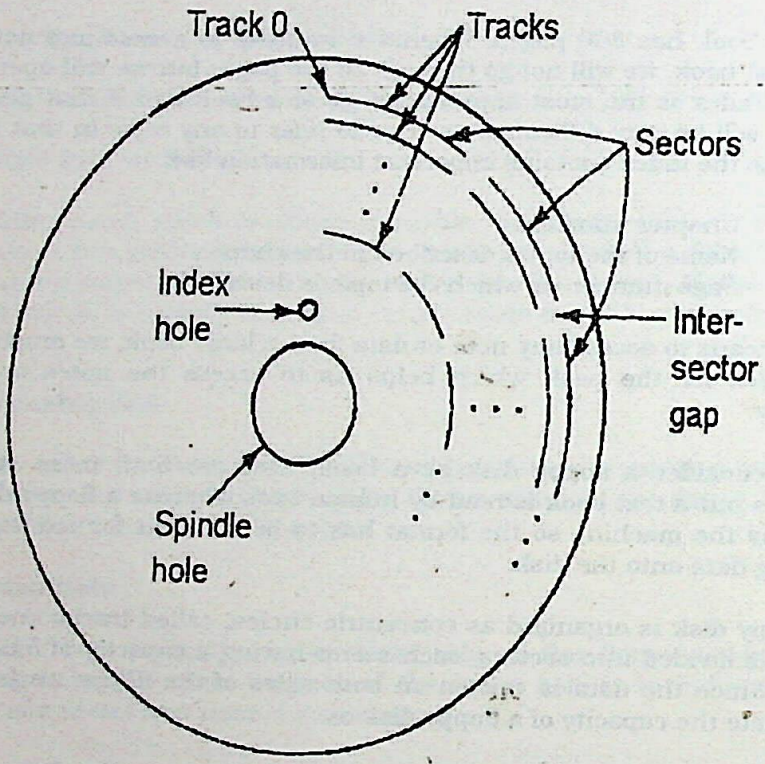

Figure 3.1 Floppy Disk Organization

The following table 3.1 gives a brief explanation of the floppies and their capacity which are normally used for PCs.

Floppy type	Size in inches	No. Of sides	No. Of tracks	No. Of sectors/ track	No. Of bytes/ sector	Total formatted capacity (bytes)
360 KB	5 1/4	2	40	9	512	368640
720 KB	3 1/2	2	80	9	512	737280
1.2 MB	5 1/4	2	80	15	512	1228800
1.44 MB	3 1/2	2	80	18	512	1474560
2.88 MB	3 1/2	2	80	36	512	2949120

Table 3.1

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This is the format of a floppy disk through which a PC system can recognize the floppy disk and read or write data onto the floppy. Whenever a floppy is formatted in a PC machine, DOS creates four different areas on to the disk.

- **Boot record**

The boot record keeps information of the DOS signature (version) which helps the system to identify a floppy disk.

- **File Allocation Table**

The File Allocation Table is a map of the disk space which keeps track of the sectors that are used, available for use and are unusable. Two copies of File Allocation Table are kept.

- **Root directory area**

The root directory area is used to store the information on the directories (like an index page in a text book).

- **Data area**

The data area of a floppy disk is where actual information is stored.

3.2 Floppy Disk Controller Overview

A floppy disk controller is a device controller which allows the interchange of information between the system memory, CPU and the Floppy Disk Drive (FDD). This device controller can support upto four FDDs.

It uses the 6th interrupt to give the status of the FDC chip and it is connected to DMA channel 2 for mass data transfer .

The importance of using the FDC chip is to provide coordination at several levels like

- → Motor and head drive signal
- → Writing and reading at bit level
- → Interfacing with the rest of the circuitry of the microcomputer

The main functions of the FDC chip are

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- → To provide circuitry and control functions for interfacing a processor to four Floppy Disk Drives.
- → To provide support to single and double density (FM and MFM) recording.
- → To provide control signals to simplify the design of an external phase lock loop and write precompensation circuitry.
- → To provide execution of fifteen high level commands including formatting, reading, seeking, writing, deleting etc.
- → To provide error detection technique by CRCC generation/checking.

The main function of the external hardware circuit can be divided into two parts, input and output. The external hardware circuit connected at the input of the FDC chip provides the following functions

- → Allows interface between the FDC internal registers and the CPU.
- → Provides bi-directional data transmission between the FDC and the CPU.
- → Provides interface of control signals and data transfer signals like IOW (Input/Output Write, IOR (Input/Output Read), DRQ2 (Data Request), DACK2 (Data Acknowledge), IRQ6 (Interrupt 6) and address lines and T/C.

The external hardware circuitry connected at the output of the FDC chip provides the following functions

- → Drive selection
- → Enabling the motor of the drive selected
- → Data separation and write precompensation logic
- → Line drivers and receivers for the signals to and from the FDD

3.3 Disk Format

Before using any new floppy diskette it must always be formatted. Without formatting a disk a PC system cannot recognize a floppy. DOS provides a command named FORMAT which organizes a disk in sectors and tracks. Each sector has its own identification field (ID field) and data field. The ID field stores information of addresses of the sectors, whereas the data field contains the actual data stored on the sector. The Format command performs following functions

- → Erases all the previous data
- → Organizes sector and tracks with identification and data field

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- → Writes specific data pattern in data field of all sectors
- → Provides unique bit pattern of the following four different address marks
  - ✓ Index address mark (beginning of each track)
  - ✓ ID address mark (beginning of each ID field)
  - ✓ Data address mark (beginning of each non-deleted data field)
  - ✓ Delete-data address mark (beginning of each deleted data field)

3.4 Floppy Disk Drive

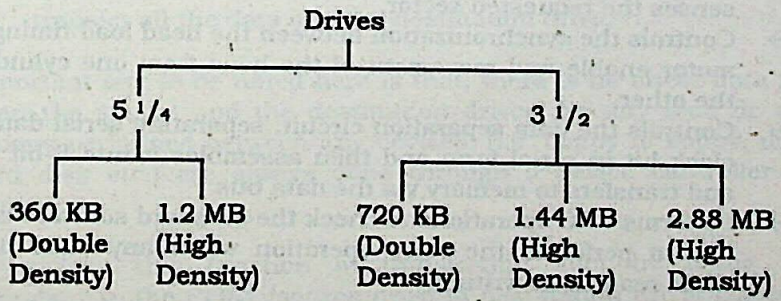
It is an electro-mechanical device which performs reading, formatting and writing operations on a floppy disk. Basically floppy drives are of 3 sizes

- → 8 inches
- → 5 ¼ inches
- → 3 ½ inches

8 inch drives were used in olden days with 8 inch floppies. The present day PCs use 5 ¼ inch and 3 ½ inch floppy drives. Even these drives are of two types.

- → Double Density
- → High Density

The following chart gives the type of drives available.



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3.5 Floppy Disk Drive Functions

The floppy drive performs the following functions

- → It senses the presence of the floppy disk as soon as the door is locked.
- → Upon selecting the drive (when drive select is active) it outputs the index pulses, track 0 sensing pulse and write protect status.
- → Controls the rotational speed of the main motor when Motor ON signal is active.
- → Controls the operation of the head stepper motor by receiving STEP pulse and DIRECTION signals from the FDC in seek mode.
- → Performs the operations of reading and writing on to the floppy disk.

3.6 Floppy Disk Controller Functions

The LSI floppy disk controller chip is an intelligent subsystem that performs the following operations

- → Manages the selection of upto four floppy disk drives.
- → Controls track selection by issuing timed step pulses and direction signals that move the magnetic head from its current location to another specified location of the track for reading and writing data. It also supports the selection of head to read the correct side of the disk.
- → Monitors the movement of the head and the track until it senses the requested sector.
- → Controls the synchronization between the head load timing, the motor enable and movement of the head from one cylinder to the other.
- → Controls the data separation circuit, separating serial data and clock bit in serial form and then assembles it into 8-bit bytes and transfers to memory via the data bus.
- → Performs CRC operations to check the standard software errors. It also performs the retry operation when any error occurs while reading or writing.
- → Generates DMA request for data transfer.
- → Outputs an interrupt request at the end of the command phase of the FDC chip.

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- → Executes the command received from the CPU and outputs the status parameters indicating the completion of the command.
- → Converts an 8-bit data byte into serial form, adding the clock bit with the data bit as per the MFM format and outputs the data to FDD.
- → Performs a typical format operation on a floppy creating the necessary bit patterns and gaps.
- → Initializes the floppy disk drive bringing the head to track 0 position during the RECALIBRATE command.

3.7 Software Function

In a PC, the BIOS program controls the software operations with the floppy drives. It contains various routines to perform the operations. These routines are called by the operating system. Whenever a block of data is to be transferred from a floppy to a hard disk or from a floppy to a floppy, the operating system will perform the operation in the following steps

- → Select the source drive
- → Read the data from the source drive and put it into memory
- → Sense the presence of the destination drive (if not detected it outputs an error message)
- → Transfer the data from memory to the destination drive

There are two ways of transferring data.

- → Reading and writing track by track from the source drive to the destination drive.
- → Read all the tracks at a time from the source drive and then transfer all the data into the destination drive.

An important fact to be noted here is that, there is no direct data path between the source and the destination drives. So any read or write operations performed between any devices (i.e. floppy to floppy, floppy to hard disk etc.) are always done through a device controller and memory.

DOS provides this function of transferring data by using DOS commands, e.g. the COPY (source drive to destination drive) command helps the user to transfer the data as per the parameters specified.

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Upon receiving any DOS command, it calls for the BIOS routines, which in turn outputs the parameters like track number or head number to the FDC and performs the operation.

3.8 Basic Structure of a Hard Disk

The basic structure of a hard disk is similar to that of a diskette. the major difference between a hard disk and a floppy disk is that the hard disk has more than two sides and is much more faster than a floppy disk.

The recording media used for diskettes are soft and hence they are called floppy disks whereas the hard disk uses a hard surface recording media which are called platters.

Physically the hard disk consists of one or more platters, each of which has two sides. The number of platters depend upon the capacity of the hard disk. Each side of the platter has a read-write head. Each disk surface is coated with a magnetic media and the read-write head stores data on it by rearranging the magnetic field. It reads data from the surface by interpreting the variations in the magnetic field.

The platters are mounted on a fixed spindle which rotates at the speed of 3600 RPM. The read-write head moves horizontally across the platters from the edge to the center so that they can read or write data to any part of the surface. All the heads are assembled with an actuator, the movement of which is controlled by a stepper motor called the head stepper motor.

A stopper is provided for the indication of track 0 when the head moves towards the outermost track. A series of concentric circles on each platter are called tracks. The division of tracks into smaller units are called sectors. The collection of tracks that can be accessed without moving the head is called a cylinder.

3.9 Types Of Hard Disk Controllers (HDC)

The most widely used HD controllers in the market today are manufactured by original equipment manufacturers in different versions, designs and with advance features. Most of the manufacturers have their own chip sets designed for specific purposes. The following are the details of the original manufacturers and their chip sets

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- **Western Digital Corporation**

  - → WD 1010 A - 05 Winchester disk controller
  - → WD 1015 Buffer manager control processor
  - → WD 10C20 Data separator and write precompensation device
  - → WD11C00-17 Logic array

- **Standard Microsystem Corporation (SMC)**

  - → HDC 9224 Universal disk controller
  - → HDC 9226 Winchester data separator
  - → HDC 9225 Disk buffer management unit

- **Longshine Electronics (LCS)**

  - → HDC 9224
  - → HDC 9226
  - → HDC 9223
  - → LSIC 6210 ASIC (Application Specific Integrated Circuit)

- **Everex Systems Inc.**

  Everex Systems Inc. offers many versions, some of which are

  - → EV - 391 (Two third size hard disk controller)
  - → EV - 3005 (Half size hard disk controller)
  - → EV - 390 (Full size hard disk controller)
  - → ST - 2338 (Half size hard disk controller)

3.10 Working Principle of a Hard Disk Controller

Basically a HDC is an interface device between the hard disk and the system mother board. The design and mode of interaction between HDC and the system (CPU, memory and DMA) are similar to that of the FDC except for some additional features. The functional modules in the HDC includes the following.

- → System interface logic
- → Disk drive interface logic
- → Sector buffer RAM
- → Data separator
- → A dedicated disk controller
- → Timing and control circuits

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→ BIOS ROM

Basically the controller converts instructions from the software running on the computer to electrical signals needed to operate the hard disk, e.g. to read a sector from the hard disk into the memory DOS calls the system BIOS which

- → Sends parameters to the controller's input/output port indicating which sector to read
- → Controller steps the head one by one on tracks until it reaches the correct position
- → Waits for the sector to come under the head
- → Reads the pulses representing the encoded information and converts them into data
- → Performs error checking
- → Writes data into the user program's buffer

XT and AT systems use different controllers. The XT lacks BIOS support for a hard disk built into the system ROM. So the XT controllers always contain a ROM which is located at address C800 (Hex) to C9FFF (Hex). It uses input/output port addresses for control register and IRQ5 as an interrupt request line for interrupt processing. Data transfer is done through DMA channel 3.

Logical functions, specification and features are irrespective of the type of controller. To maintain compatibility the following specifications are maintained :

- → Port address
- → Format of codes and commands
- → Format of status bits
- → Interrupt line used (IRQ5 for XT and IRQ14 for AT)
- → Protocol type (ST 506 or ST 412)
- → Transferring data through DMA
- → 512 bytes of data per sector

The various features associated with HDC board are

- → Data transfer rate of 5 MB/sec
- → Supports two hard disk drives with different configurations
- → Partitioning facility for dividing a physical drive into more than one logical drive
- → On board self adjusting data separation logic
- → Error correction facility
- → CRC checking facility for ID field

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- → On board write precompensation logic
- → 32-bit ECC (Error Correction Code) polynomial for error detection and correction
- → Internal diagnostics
- → Diagnostic read and write features for verifying ECC logic
- → Retrieve errors with selectable rate
- → Auto restore and re-seek on all seek errors
- → Automatic formatting
- → Built-in seek features available on all commands
- → Overlapped seek capability on buffered step drives
- → Multiple sectors read and write
- → Sector interleave compatibility

The HDC communicates with the CPU and the DMA controller via the Address bus, Control bus and Data bus.

The Data bus is used for the following purposes

- → CPU to read the HDC BIOS
- → CPU to send command and command parameters to the HDC
- → HDC to send status and status parameters to the CPU
- → HDC to send data to the memory (DMA mode)
- → HDC to receive data from the memory (DMA Mode)

The Address bus is used by the CPU for sending the 16-bit port addresses, for sending the command and command parameters to the HDC and receiving status and status parameters from the HDC. It also reads the HDC ROM BIOS by outputting a 20-bit address line. The port address decoding logic decodes the address supplied by the CPU to select one of the four different port addresses whose address and functions are given as follows

Port Address	Port Type	Remarks
320	Input	Data Port
	Output	Data Port
321	Input	Hardware Status Port
	Output	Reset Port
322	Input	Drive Configuration
	Output	Controller Select
323	Input	Not Used
	Output	DMA and Interrupt Mask Register

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3.11 Parallel and Serial Ports

The PC consists of a microprocessor, memory, and devices. The PC supports a wide variety of devices, including your video adapter and keyboard. Parallel and Serial ports are general-purpose interfaces that are incorporated into almost all Pcs. These ports enable you to attach standard peripherals, such as a printer or a mouse.

A Parallel port receives and transmits data one byte at a time. A Serial port receives data from and transmits data to the PC one byte at a time, but it receives data from and transmits data to external devices one bit at a time.

Summary

The most common devices used for mass data storage are the magnetic tape, the floppy disk, the hard disk and the optical disk.

Magnetic Tapes are basically used for keeping backups of data as their access time is too long.

Floppy disk, Hard disk and Optical disk are acceptable for daily usage, as their access time is much faster than the magnetic tape.

A Floppy disk consists of

- Write Protect Notch
- Clamping Hole
- Index Hole
- Head Slot

A floppy disk is organized as concentric circles, called tracks.

Each track is divided into sectors, each having a capacity of 512KB of data.

The four areas created by DOS on a disk are

- Boot Record
- File Allocation Table
- Root Directory Area
- Data Area

A floppy disk controller is a device controller which allows the interchange of information between the system memory, CPU and the Floppy Disk Drive (FDD).

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Any read or write operations performed between devices are done through a device controller and memory.

A Parallel port receives and transmits data one byte at a time.

A Serial port receives data from and transmits data to the PC one byte at a time, but it receives data from and transmits data to external devices one bit at a time.

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SECTION II

DATABASE MANAGEMENT SYSTEMS

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Chapter 1

Database Management Systems I

The topics covered in this chapter are:

* *Data, Processing and Information*
* *Data organisation*
* *Types of Files*
* *Processing Systems*
* *Logical concepts of data*
* *Database Objectives*

1.0 Introduction

In an organisation data is a resource that enables effective and successful operation and management. It gives an organisation an image of past trends; enables it to make better decisions for the future.

The recent use of computers has forced greater discipline on the management of data.

1.1 Data, Processing, Information

Data

Data is a collection of facts, figures, statistics which can be processed to produce meaningful information.

Processing

Data processing consists of three basic activities :

- **Capturing the input data** - data must be recorded or captured in some form before it can be processed. Data may first be recorded on source documents or input directly through direct input devices.

- **Manipulating the data** - the following operations may then be performed on the gathered data :

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- **Classifying** - similar items are organised into groups or classes. Items may be assigned predetermined codes. The codes used are numeric, alphabetic and alphanumeric

- **Calculating** - arithmetic manipulation of the data is called calculating

- **Sorting** - data is arranged in logical sequence

- **Summarising** - masses of data are reduced to a more concise and usable form

- **Managing the output results** - once data is captured and manipulated, it may be :

  - **stored and retrieved** - data is retained for future reference. Recovering stored data and/or information is the retrieving activity

  - **communicated and reproduced** - data may be transferred from one location or operation to another, for use or for further processing. It is sometimes necessary to copy or duplicate data. This reproduction activity is done by a machine

Information

Information is processed data. It refers to facts, figures or statistics that have meaning.

1.2 Data Organisation

To ensure effective processing and useful output, data is organised into related groupings. The required form (numeric, alphabetic, alphanumeric) of the input data may vary from one program to another.

A small unit of data is the **data field** (or data item). The data field consists of a group of characters treated as a single entity. A collection of related data items treated as a single unit is called a **record**. A **file** is a number of related records that are treated as a unit.

A **data base** is a collection of logically related data elements. These may be structured in various ways to meet varying processing and retrieval

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requirements. For example, a bank may have separate files - savings account, automobile loan, and personal loan etc. The bank's customer data base would include records from each of these files. Using a series of programs, data on any customer may be retrieved and updated.

1.3 Types of data files

Master file

Master files are perpetual files i.e apart from the time of creation they are never empty. Further, they maintain information that remains constant over a relatively long period of time. When the information changes, the master file is updated. The normal methods of updation are by adding, deleting, or editing records in a file. For example, when a new employee joins the organisation, details on the employee would have to be added to the employee master file. Similarly, a record would have to be deleted when an employee leaves the organisation.

Transaction file

Transaction files are files in which data prior to the stage of processing is recorded.

The data in transaction records may be collected automatically or may be initially recorded on source documents and later converted to machine readable format.

A transaction file may be a temporary file, that is retained until the master file is updated. After the transaction file is processed it is usually re-initialised and further transactions are then recorded in it.

Examples of transaction files are :

- customer's orders for products (to update an order file)
- details for price changes for products (to update a product file)
- details of cash postings to customer accounts (to be held for audit purposes)

Transaction files may also be saved to :

- maintain a permanent record of transaction data
- source documents on which transaction data was initially recorded can be discarded

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- master files can be re-created in case the original file is destroyed or damaged
- trace the processing when transactions occur and when the master file was updated

Backup Files

The data on master files and transaction files is vital to an organisation. It therefore, needs to be protected. Backup files are created for this purpose. In case files are accidentally destroyed or damaged, the original files can be re-created using these backup files. These facilities are provided by system security software (eg. dump/restore utilities).

In batch update systems, when a file is updated, the earlier version is often maintained in the system along with the transaction file used for the update. The older file then becomes an earlier generation file or "parent" of the new data file. Upto three generations of a file may be maintained automatically by an operating system or by applications software.

In case of loss or damage to the data file an earlier version may be used to recreate it.

However, when files are updated on-line, no such versions are produced. Instead periodic file dumps are made by the operating system. A log of transactions is also maintained.

1.4 Processing Systems

Batch Processing

In batch processing data is collected into a group or batch before being entered and processed. The input data are typically recorded on source documents before being converted into a machine readable form. For example, preparing bills, processing payroll cheques.

On-line Systems

An on-line system is one in which the system interacts directly with the user. As soon as the user inputs data it is processed immediately. The system validates data at various points, and ensures that correct data is being entered.

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Multiple terminals are linked to the main computer. The terminals may be a VDU with a keyboard, or specialised terminals like those for bank transactions.

Real-time Processing

Real-time systems are on-line systems with tighter constraints on response time. In these systems the data is processed and results are generated fast enough to influence on-going activity or the real-time environment.

With real-time processing, master file records are updated as soon as transactions are entered into the system. Data is not stored temporarily on a transaction file. For example, an inventory file is updated as soon as a sale is recorded.

On-line Transaction Processing

In this system input data are entered into an on-line transaction terminal. The record is located, retrieved, updated and the transaction is printed out. This type of interactive processing is referred to as on-line **transaction processing.** For example, at a bank, data is entered into an on-line terminal in response to certain questions on screen. The system locates and retrieves the account. The balance is updated and the transaction printed out.

Data base as different from files

The term "file" refers to a collection of records. Each record is of the same type and format description. A database is a collection of interrelated records, describing entities from one or more entity sets.

1.5 Logical concepts of data

A data base is a collection of information about **entities** (people, organisations, positions, policies, orders, parts). **Attributes** describe entities (age of person, budget of organisation). **Values** of attributes represent the actual data pertaining to specific entities. Entities with similar attributes (eg. all the employees in an organisation) form an entity set.

Relationships may exist between entities and are usually represented by additional attributes. For example, recording the number of the

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organisational unit for which an employee works establishes a relationship between these two entities.

Data base file organisation

There are three ways of organising computer files :

- sequential
- direct-access
- indexed sequential

With sequential files records must be organised in a particular order. The specified order may not be of use to all users. Further, it does not allow for efficient querying or record insertion.

Most data bases are constructed as direct-access or indexed sequential files. These methods allow for efficient querying and record insertion.

Physical and logical files

"Physical file" refers to where the records physically reside on disk and the method of file organisation.

"Logical file" refers to the data requirements of an application program. It defines how the application program wants information in the file to appear. For example, an inventory file may physically be a direct-access file. However, during stock-taking a sequential listing of all records may be required. Thus the application program treats the direct-access file as a sequential file.

Data bases must have some sort of physical structure. However the data can be accessed and used in logical ways that are independent of the way records are stored.

Schemas and subschemas

A data base **schema** is a broad term that describes all the information in a data base. For example, for a personnel application, the data base schema might include such employee files as health insurance, provident fund, employee test results.

However, in most data base applications, individual users require only specific subsets of file information, eg. only retirement information. In addition, many data bases have some information that is confidential (eg. employee test results) and therefore must be protected. The term

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subschema refers to a subset of data base information that is made available to specific end users.

Data dictionaries

It is a computer file that contains "data about data". Each computer record of a data dictionary contains descriptive information about a single data item. (Fig. 1.1)

When new data fields are added to the record structure a new computer record is created in the data dictionary. When new computer programs are created an updated data dictionary indicates the data items that these new programs access. When data fields are deleted from the structure of file records, their corresponding records in the data dictionary are deleted.

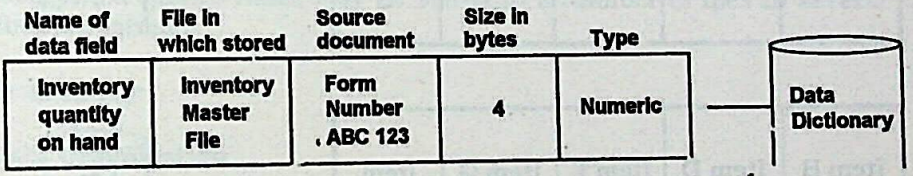

Fig. 1.1

Database Definition

Database definition defines the logical structure, contents of a stored data base.

Stored data is ultimately represented by a sequence of physical blocks, each block being a linear sequence of characters. A logical view of the hierarchical structure is possible without knowing its linear stored representation.

The user thus does not need to know the details of physical storage and access mechanisms.

1.6 Database objectives

The organisation of data in a data base has three major objectives :

Reduce data redundancy

The same basic data fields are often included in many different files. For example, data on an employee (name, address, age, grade, basic, hra)

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may be contained in separate files - personnel, accounts. Files may be combined in a common data base thus reducing data redundancy. (Fig. 1.2)

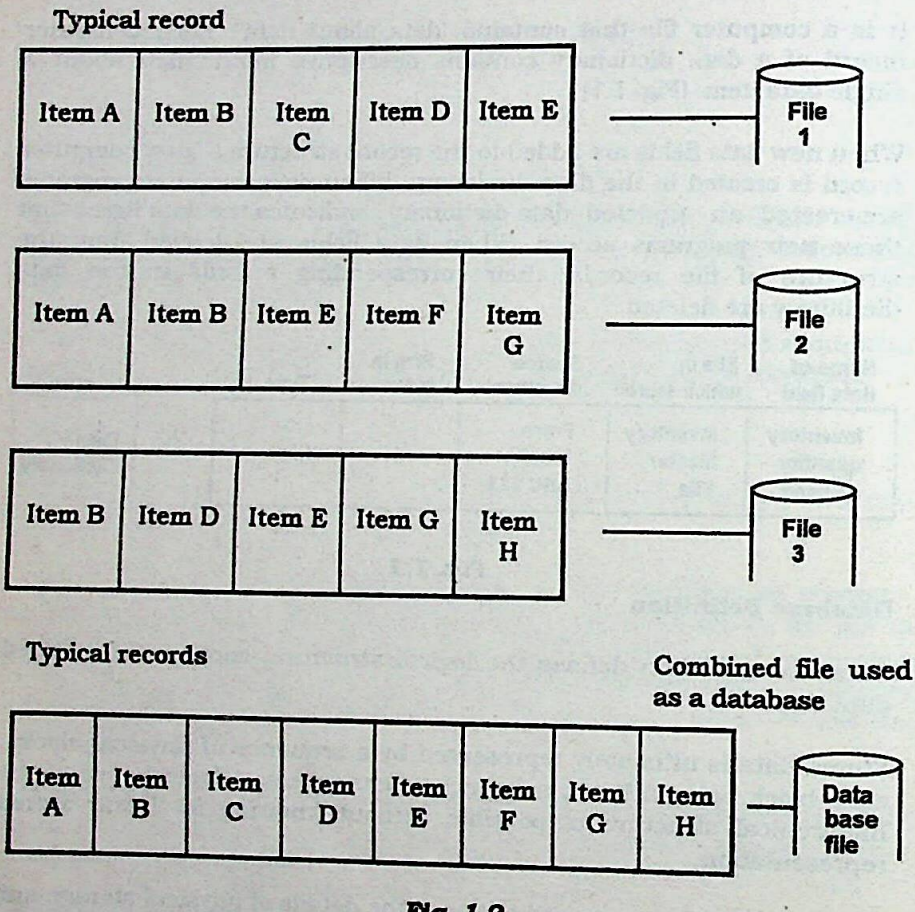

Fig. 1.2

Data Integration

In a database, information from several files is coordinated, accessed and operated upon as a single file. Logically, the information is centralised; physically the data may be located on different devices and in widely scattered geographical locations, connected through data communications facilities. In order to achieve the objectives of data centralisation, links between the data must be maintained. Direct access techniques are generally used to permit efficient and flexible

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linking, although in some circumstances sequential organisation may be used

Data Integrity

If a data item is contained in more than one file, then all copies of the files must be updated if that item is changed. In a database, however, only one copy of the data is held. The data is therefore consistent, and redundancy is eliminated.

Data Independence

In conventional file systems, if the format of a file is changed, then all programs which access that file must be changed. A database allows the organisation of data to be changed without the need to reprogram. It allows programs to be modified without reorganisation of the data. For example, a client's name may be stored in a number of files in several different formats.

Summary

Data Organisation

To ensure effective processing and useful output, data is organised into related groupings - record, file, data base.

Data base as different from files

A "file" refers to a collection of records. A database is a collection of interrelated records, describing entities from one or more entity sets.

Physical and logical files

"Physical file" refers to where the records physically reside on disk and the method of file organisation.

"Logical file" refers to the data requirements of an application program. It defines how the application program wants information in the file to appear.

A Data Dictionary is a computer file that contains data about data.

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I can assume that a "Do Not File" document is filed in a "Do Not File" file.

Senator Frank Church

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Chapter 2

Database Management Systems II

The topics covered in this chapter are :

* *Objectives of Database Management*
* *Hierarchical databases*
* *Network structure databases*
* *Relational databases - elementary concepts*
* *Database Administrator*
* *DBMS functions*
* *Advantages of DBMS*

2.0 Introduction

A resource must be properly managed if it must be used in the present and in the future. It must be easily available; its use controlled so as to maintain its integrity. Management thus implies both control and use. Database management involves the control and use of data resources in an organisation.

2.1 Objectives of Database Management

- **shareability** - different people and different processes must be able to use the same actual data at virtually the same time

- **availability** - both the data and the DBMS which delivers the data must be easily accessible to the users

- **evolvability** - the ability of the DBMS to change in response to growing user needs and advancing technology

- **database integrity** - since data is shared, adequate integrity control measures must be maintained

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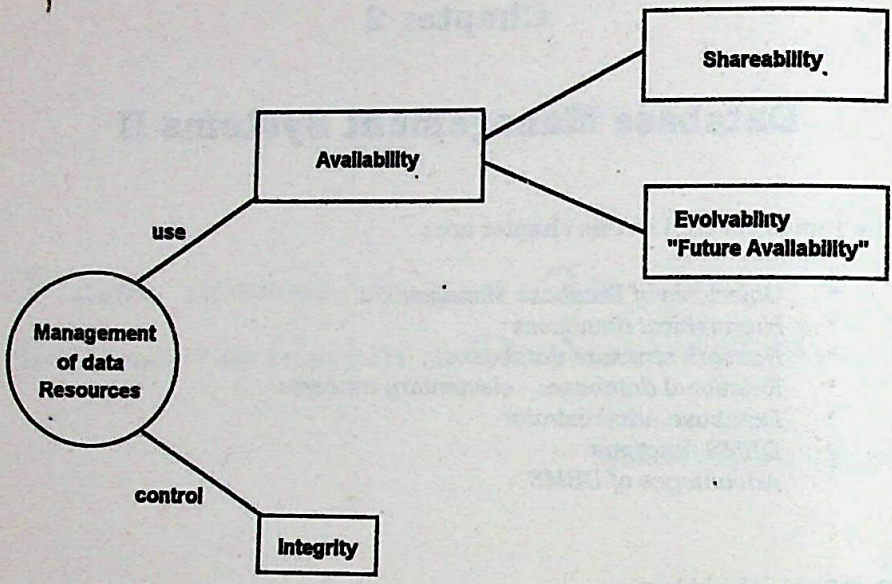

Fig. 2.1 Objectives of Database Management

2.2 Hierarchical Structures

Data units are structured in multiple levels. The structure graphically resembles an inverted tree with the root at the top and the branches formed below.

There is a superior-subordinate relationship in this structure. Subordinate elements or nodes are connected to a single root data component. These, in turn, "own" one or more other elements (or none). The "elder", or high-level data, is sometimes called the parent record, and the "younger" or lower-level data is called a child record. Each element or branch has only a single owner. The branches in a tree structure are not connected. For example, the line items of a single purchase make up a sales invoice, sales invoice may be grouped by customer, he customers classified by salesman, and the salesmen identified by sales office.

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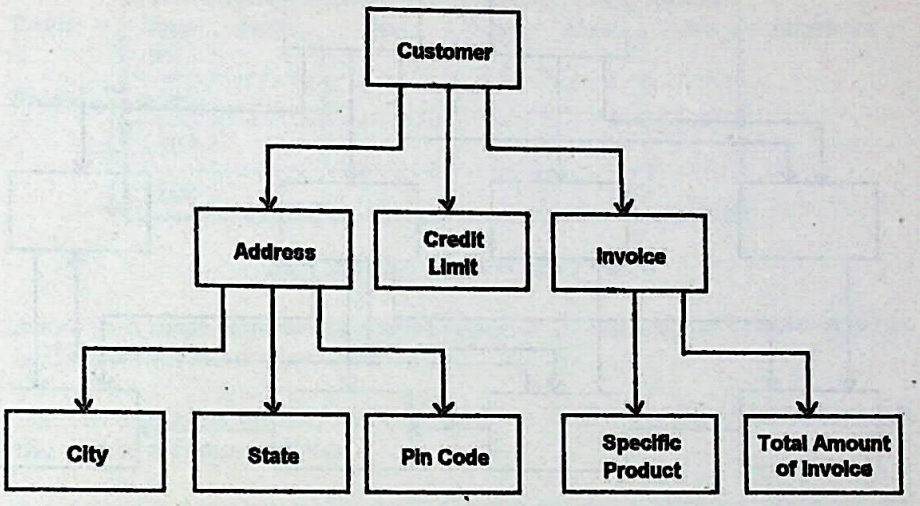

Fig.2.2 Hierarchical structures

"Records within records" are stored on the file. Each parent record acts as a natural control break for its children records in the file.

Hierarchical files can also be organised by storing like records together in linked subfiles.

For example, items of the same sales invoice are stored together on the file. The sales invoices of the same customers are stored together. Data records for the same sales person are stored together. A sales report can be created by linking item information together.

2.2 Network Structures

In network structures (Fig. 2.3), nodes can be connected in a multidirectional manner. Each node may have several owners. These in turn, may own any number of other data units. The user is allowed to order data internally and link similar records together. Data is represented by records and links. Information can be retrieved by beginning with any record in a file.

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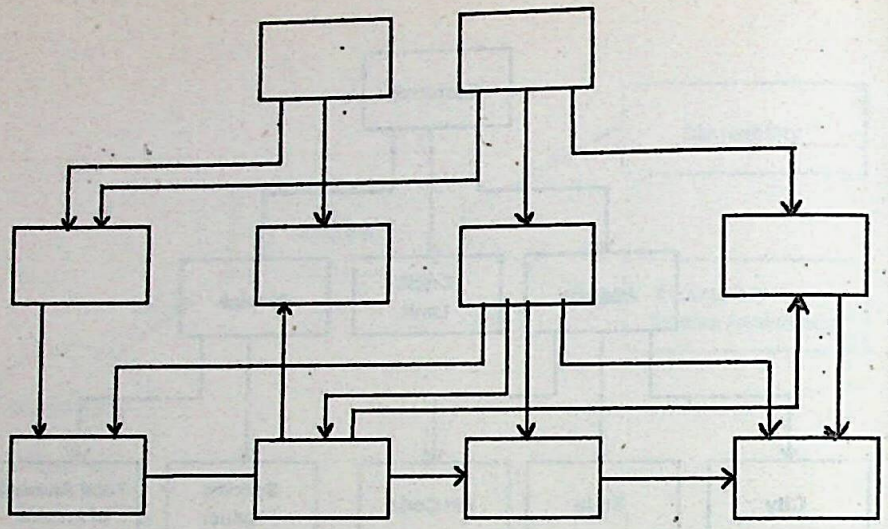

Fig. 2.3 Network structure

However, it is difficult to create the data base in the first place. Keeping track of where like records are stored is difficult. Once the data base is created it is difficult to link computer records in new ways. The codes defining the network links must be created in advance.

Hierarchical and Network DBMSs are designed for minicomputer and mainframe systems. These are controlled by database administrators who identify the logical relationships between records. A special data definition language is typically used for this purpose. A special query language may be used to retrieve stored information. With the necessary data linkages these structures may be faster than relational products. They, however, lack the flexibility of the relational structure.

2.3 Relational Structures

A relational DBMS manages data in more than one file at a time. The files are treated as **tables** with rows and columns rather than as lists of records. Each table column represents a data base field or **attribute**, and each row a data base record - sometimes called a **tuple**. The range of values of an attribute is called the **domain**. (Fig. 2.4)

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Employee File = Table

Tuple →

Emp No.	Name	Add.	Basic	Grade	HRA
1101					
1103					
1105					

← Attribute

Domain ↕

Fig. 2.4 Relational structures

A row in a table represents a **relationship** among a set of values. A table is thus a collection of relationships.

Data in one table (or file) can be related to data in another table through the use of a common field.

A relational data base also includes one or more indexes. Indexes are used to access data from a data base in different ways.

Relational DBMSs allow for flexible data storage and retrieval. To add to a relational database, it is not necessary to redesign files. New rows and columns are added in new tables. These tables are related to existing tables through common key fields.

Data can be reorganised and new tables created by selecting certain rows or specific columns from other tables. Columns and rows from two separate tables can be joined.

For example, An inventory file may be organised by 1) dealer 2) type of assembly. The file may also be organised 3) numerically by item number 4) alphabetically by item description. To allow the user to access the file in all these different ways a set of indexes may be used. each index consists of two entries 1) reference value such as dealer code 2) disk address indicating where the respective records are stored. A list of items by dealer may be generated using the dealer index to access inventory records by supplier.

Example of RDBMS - Oracle, Ingres.

Query languages are used for data retrieval. These languages are typically at a higher level than standard programming languages. Query languages can be procedural or nonprocedural. In a procedural language, the procedure to compute the desired output is defined. In a

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nonprocedural language, the user describes the desired output without giving a specific procedure for obtaining the output.

A complete data manipulation language (DML) includes not only a query language, but also a language for database modification. These include commands to insert and delete tuples as well as to modify parts of existing tuples.

2.4 Advantages of RDBMS

- a variety of file enquiries can be accommodated in an efficient manner
- additional indexes can be constructed for subsequent data processing requirements
- allows for flexible database creation and modification when additional relationships must be defined

Disadvantages

- indexes are created and maintained along with the file records themselves. Two separate files are thus created
- the index portion of the file may be larger than the file itself. This wastes storage space
- file index must be searched sequentially before the actual file records are obtained. This wastes time

2.5 The Functions of Data Base Management Systems

DBMS are special computer programs that act as an interface between files and application programs. (Fig. 2.5) They can :

- create, add, delete, or modify records
- records can be sorted into a predetermined sequence according to one or more data fields in each record
- modify file chains or rings
- use specified criteria to find and display the contents of one or more records
- generate user specified reports

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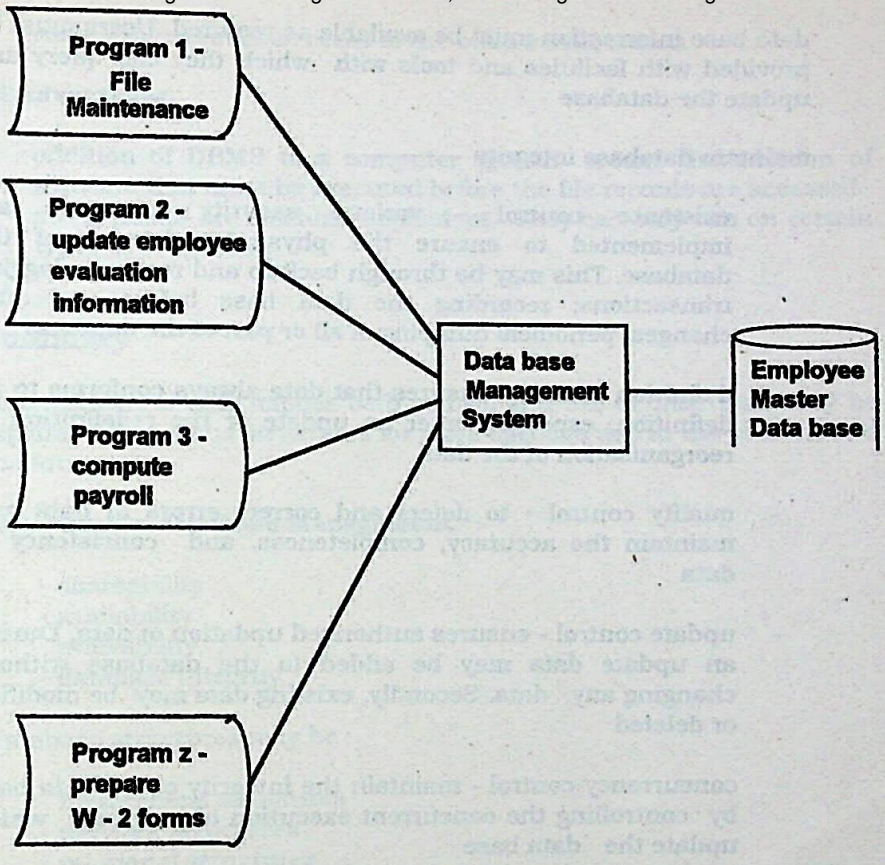
Program 1 - File Maintenance
Program 2 - update employee evaluation information
Program 3 - compute payroll
Program z - prepare W - 2 forms
Data base Management System
Employee Master Data base

Fig. 2.5

2.6 Data Base Administrator

A data base administrator is in charge of an organisation's data bases. Typical responsibilities of a data base administrator are :

define, create, redefine, and retire data

Valid data must be captured and stored according to predefincd logical and physical structures. The existing data structure must be modified according to new data needs; old data stored in history files.

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data base information must be available as required. Users must be provided with facilities and tools with which they can query and update the database

maintain database integrity

- existence control - various security measures are implemented to ensure the physical existence of the database. This may be through backup and recovery; logging transactions; recording the data base before and after changes; periodical dumping of all or part of the database

- definition control - ensures that data always conforms to its definition, especially after an update or the redefinition or reorganisation of the data

- quality control - to detect and correct errors in data and maintain the accuracy, completeness, and consistency of data

- update control - ensures authorised updation of data. During an update data may be added to the database without changing any data. Secondly, existing data may be modified or deleted

- concurrency control - maintain the integrity of the data base by controlling the concurrent execution of programs which update the data base

- access control - to protect data from unauthorised access

2.7 Advantages of a Data base Management System

- allow different business applications to use the same files

- free programmers from technical details of file inquiries, maintenance, updating and reporting.

- allow users to create, manipulate and maintain their own data bases

- data from separate data files is combined into an organised set of data thus reducing redundant information

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each subsystem has access to the other's information

Disadvantages

- addition of DBMS to a computer system means the addition of software that must be executed before the file records are accessed
- many DBMS are machine-dependent. They can only run on certain types of computers

Summary

Management of data implies both control and use of data. Data may be organised in various structures for more effective use in the present and the future.

Objectives of Database Management

- shareability
- availability
- evolvability
- database integrity

Database structures may be :

- hierarchical structures
- network structures
- relational structures

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SECTION III

INFORMATION SUPERHIGHWAY

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Chapter 1

The Information Superhighway

The topics covered in this session are:

* *What is the information superhighway ?*
* *The Components*
* *Applications*
* *Some examples*

Over the past few decades the focus has shifted from factories and large organisations to information. We have moved from the industrial age to an era that is often called the "information age". An age in which the importance of information cannot be overly emphasised. Technologies are dedicated to the storage and retrieval of information - electronically.

1.1 What is the information superhighway?

Before we go on to discuss the information superhighway, and its applications, let's deviate a little. Whether we realise it or not, we are all part of one network or another. For example, the telephone we use is part of a network of other telephones. When we make a phone call a connection is established between us and the receiver. In the case of Cable TV, once again we are connected. Or television is connected via cable to a central point. We all receive the same programme, at the same time. Another familiar network is that of the computer network. If you have the appropriate equipment you can connect one computer to another.

At present, each of these - telephone, television, computers - are individual networks using separate technologies. While telephone and television use analog signals, computers use digital signals. Now what? Again there is equipment that converts digital signals to analog and back (modem! for example). Now imagine a stage where all these three technologies are combined so that each individual network can be inter-linked into one infrastructure providing us information when we want it, where we want it and how we want it. Sounds like a dream? It isn't.

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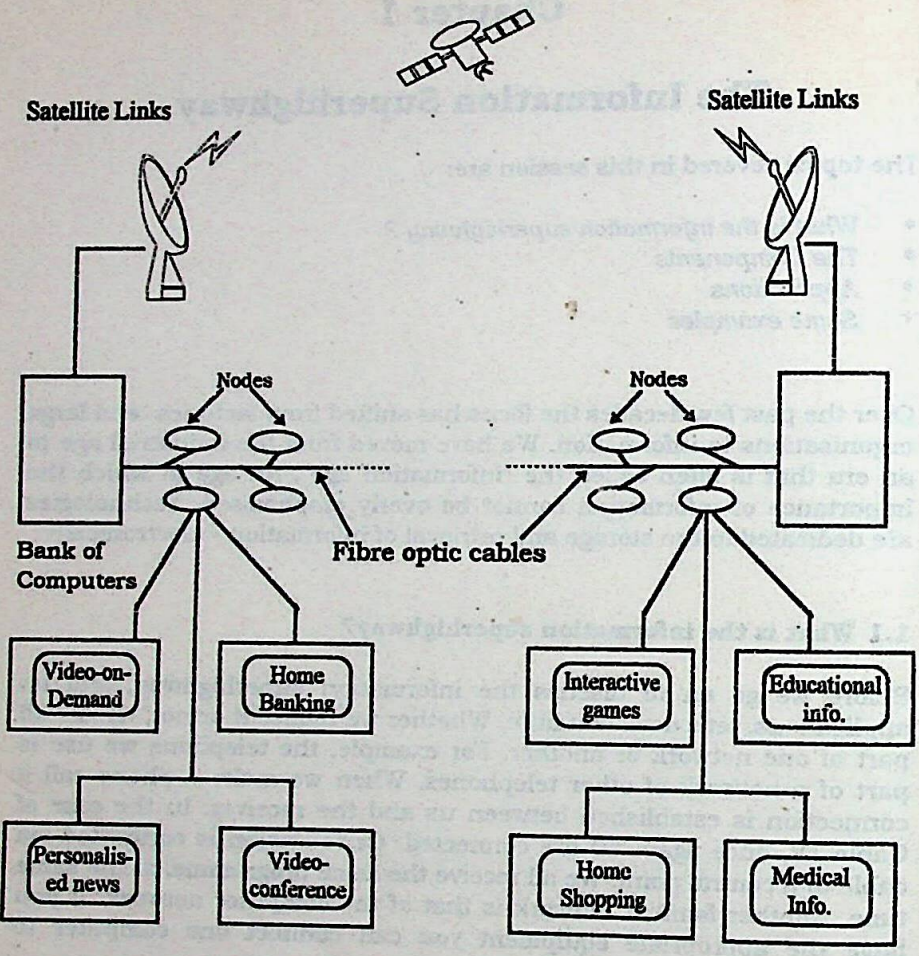

Fig. 1.1 The Information Superhighway

The information superhighway is the result of the convergence of television, telephone, and computer data communications into a single, integrated, compatible network.

It will be an electronic road on which all of us will travel in the near future. An electronic road that will cover the globe. On this highway information will be available in a variety of forms - text, numeric, sound, voice, and video.

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An important factor is that the information and services available would be accessible to all. If we go by the current scenario, to access an electronic network you need some knowledge of personal computers and an understanding of how to navigate on the network. If you wish to go surfing on the Internet, for example, you need to understand networks and the Internet's own unusual categorisations of information types. The superhighway will allow voice, touchscreen, or keypad access through user-friendly interfaces that will manage the technical details required to access the information superhighway.

In addition, it will offer the advantage of multimedia. Video, data, photographs, images, text, graphics, and voice will all be available over the same cable and console linking the neighbourhood, the country, and the world through various communications methods.

It is said that when fully deployed, the information superhighway will allow over six billion people to obtain information from anywhere in the world.

Goals

The goal of the information superhighway is:

- simple, intuitive access method, like the telephone and television
- it should be interactive, like telephone and personal computer network conversations.
- it should have freedom of choice, like VCR and cable television programming.
- it should allow customised information delivery and entertainment, like personal computer networks.

Fill in the blanks:

1. The information superhighway is the result of the _____ of television, telephone, and computer data communications into a single, integrated network.

2. Information will be available in a variety of forms _____, _____, _____, _____, _____

1. convergence
2. text, numeric, sound, voice, and video

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1.2 The Components

Let us look at the three main technologies that will be used to build the information superhighway.

- **Communication**

The most common method of communication between two distant users is through the telephone. The telephone allows us to contact anyone we wish, provided we have the number. It is a two-way communication medium whereby we receive a response from the other end. This allows a certain amount of interactivity. The main drawback, however, is that it is a voice-only medium. Unless of course, you have a personal computer and a modem. A modem at your end converts the digital data from your computer into analog signals which can be carried over telephone wires. At the receiving end a modem re-converts the analog signals to digital. In that case communication is not limited to voice-only.

- **Television**

Television allows access to entertainment and information. While it allows for generic, simple access the main drawback is that it is a one-way communication medium. Programmes are limited to what the television network offers. Channel reception being limited by the strength and position of a broadcast signal relative to the strength and position of a television.

Cable TV saw increased programme choice and improved signal quality. With cable, programmes are transmitted through a coaxial cable directly to the subscriber's home from a central service point. However, you still cannot choose the programme and time to suit your requirement.

- **Computers**

A personal computer gives you access to a wide variety of information. You can customise the information and entertainment to suit your requirement. And when a PC is linked to a network you can travel beyond a single pre-programmed track. You can use programs that are installed on another computer/s on the network. Many a time there needn't be anyone on the other end. For example, you can leave a message in the "mail-box" of another user without having to worry about time zones and working hours. On the other hand, you can also receive information from other users on the network. The PC thus allows for a measure of interactivity.

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The PC allows you to choose where you want to go and how you want to get there. And you can travel to multiple destinations, simultaneously.

Oracle Corp. has introduced software that allows computers to store and retrieve still pictures, video, sound, and text.

The PC however has its limitations:

- they are difficult to use, as perceived by the average user.
- they are relatively expensive
- their full power and functionality is apparent only when they are part of a network of computers.

Furthermore, current networks have limited capacity. They use telephone lines that allow the flow of voice communications or data, but not both, simultaneously.

The information superhighway aims to use the communication ability of the telephone, the entertainment (or, should we say infotainment), facility of television, and the interactivity of computers.

The building of the information superhighway thus depends on developments that take place in the field of computers, electronics, and networks.

For example, the currently used copper twisted-pair voice-oriented cables used for telephones need to be replaced with equipment that will enable them to carry full-motion video, for example fiber-optic cables.

Another area is the need for set-top consoles that connect to the television in the same way that cable television converter boxes do now. This would allow for additional control of programming and interactive services to the consumer.

In the field of telecommunications, developments will be in the increased use of fiber-optic cables, advanced network software, and switches.

Fill in the blanks:

The three main technologies that will be need to build the information superhighway are .....

Answer

communication, television, computers

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1.3 Applications

What are to be the likely applications for the information superhighway?

1. Infotainment

Entertainment and information services will be among the first superhighway offerings. These applications will be built on multimedia, virtual reality, and interactive networking technologies. The most talked about entertainment service being video-on-demand. Besides movies, multimedia applications for interactive learning, home-shopping, and communicating will be major breakthroughs in the use of technology.

Users can customise entertainment provided by commercial and non-commercial organisations.

2. Interactive Advertising and Home shopping

Imagine a vast video catalogue of goods and services - free of connect charges. Shopping for a new car - switch to car channel where you can take a video test drive, read product specifications, and check out the available colours. Shopping for clothes dial Hi-fashion TV where you can select from a menu of designers. If its software that has to be purchased, connect to software channel, download a demo version of the latest version. If you like it, download the full version of the program and charge it.

It would allow for the buying and selling of products and services world-wide by consumers and corporations. There will be products and services available that would allow individuals and businesses to build multimedia advertisements offering their products and services.

Home shopping would be far more interactive allowing the user to find the best possible item at the best possible price. when required.

3. Interactive Education

Interactive education for students at all levels. Schools of the future will have information superhighway services that encourage and support interactive education, distance learning and self-learning.

Students may choose to use a multimedia interactive learning environment from the school's library or may sample ones from other

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schools or universities, national research centres, or even other countries. Other students may conduct extensive electronic conversations to learn from other students or experts of other parts of the country or other parts of the world.

4. Financial transactions

Home-banking is another service that may be offered on the information superhighway. Financial transactions would involve the sending and receiving of electronic money (e-money). For example, if you were to make an outstation call, you could transfer Rs. 300 to the automatic pay phone. The call may eventually amount to only Rs. 143, so the pay-phone will transfer back Rs. 157 to you.

If you need paper cash you could always transfer the required amount to an ATM (Automated Teller Machine) and collect the required cash.

5. Daily living

Making hotel reservations, booking travel tickets, and car rentals could be superhighway offerings. Imagine experiencing a holiday trip before actually making your reservations. Imagine having the seating arrangement of an aeroplane displayed on screen. You can select and book the seat you want simply by clicking on it.

6. The world's your stage

Learning a language, about a country and its people, culture, and customs wouldn't be limited to what the encyclopaedia and travelogues have to offer. You could interact with living representatives of other countries.

7. Telemedicine

The information superhighway will provide new healthcare services such as remote diagnosis and the "on-line doctor".

Doctors can have access to all the required information regarding a patient - from hospital records, or clinical databases. They would have access to the records and diagnosis of other medical practitioners in similar cases.

Medical facilities would be available in the remotest locations, immediately.

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Interactive video applications would allow for consultations among doctors, lectures on medical knowledge, no matter where the doctors, students, or patients are located.

Doctors could make electronic "house calls" since the superhighway would allow for a direct path from the hospital, research facility, or doctor's office into individual homes.

8. Interactive video games

You are no longer restricted to playing interactive video games with someone sitting right next to you. You can play long-distance. The idea here is that you can play video games with or against a distant rival who may be someone across the neighbourhood or even city, with the help of the highway. Sega has already demonstrated an interactive gaming system. There are likely to be more applications.

9. Business videoconferencing

Meet with your boss, peers, customers from your office conference room or home. A face-to-face meeting without any of the expense or inconvenience.

10. Two-way TV

You plant a camera next to your TV/PC, and call someone else who has a camera attached to their TV/PC. The disadvantage of course is that you may lose your privacy.

Give two applications of the information superhighway.

a. at home
b. in office

1.4 Examples

It is unlikely that we will wake up one day to find the information superhighway in place and ready to go. It will more likely be a process where each service will gradually come on-line and become available to the consumer. There will be no ribbon-cutting, no speeches, no inauguration ceremonies. It will just become a part of our daily lives.

In fact, some of the components of the information superhighway are already existing. Here are a few examples:

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I

The Orlando area is the test bed for the multimedia and virtual-reality technologies that will support future information superhighway applications for information and entertainment.

Time Warner Cable plans to provide users with access to an interactive network through their television cable systems.

Customers receive a "smart" cable box, a simple remote control, and a colour printer to print out material accessed through the television.

The essential goal of the Full Service Network is that customers be able to access shops, games, conversations, education, and movies from home using their TV and remote control.

The full menu of services include:

- enhanced analog cable television

- video on demand : a service allowing each customer immediate access to motion pictures and other digitally stored television programming. You can pause, rewind, fast forward, and even stop the cable movie

- video games. You can play with another user in the system who may be next door or even across town. Rather than using dedicated video-game machines, these applications only require the navigation and network connections that are part of the cable-based system.

- Interactive video shopping at "stores". The service provides access to full-motion video of merchandise with immediate ordering available through the keypad.

- distance learning through interactive educational instruction, allowing full-motion video coverage of the participants in a classroom exercise to be transmitted between two or more locations. It also includes access to such video from homes, either in real-time or in digitally stored courses.

- access to libraries and library services.

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- banking and other financial services.
- driver's licence renewal or tag registration
- videoconferencing, offering full-motion video that connects and displays participants from two or more conference sites.
- access from homes and businesses to long-distance telephone service
- personal communication services, such as mini-cellular communications devices. These would work with the computer technology in the "smart" cable box, providing network access through that entry point.
- full-motion video picture phone service on full-sized TV screens
- high-speed data transport for business.

This plan however has its limitations. It would be difficult to provide sufficient capacity for simultaneous access to network applications.

II

In Telluride, Colorado can be found the precursor to the information superhighway: The Telluride institute created something called the Infozone - a computer-based network that allows community members with personal computers to connect electronically with each other and with the world-wide services of Internet.

Residents can stay in touch with the outside world. They can conduct businesses that can work through remote channels. Future plans include building voice, data, and video connections for the network for schools, libraries, and museums.

III

Another model that is based on the concept of the information superhighway is the French Minitel system. Telephone users in France may choose to install a computer terminal as part of their service. These terminals provide directory assistance at the touch of a few keys. The system also automatically dials the number.

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In addition to directory services, Minitel's service providers offer banking, insurance, and order processing transactions as well as bulletin board services including sports results and dating services.

Minitel services are based on videotext technology. The services provided in France are what you are likely to find on the superhighway.

IV

Singapore also has a videotext system, called Teleview. It requires special terminals, which are capable of receiving high-quality photographic images. Personal computer users can get their systems to mimic the terminal via a cumbersome set of add-on gear, including circuit boards and a modem. Teleview services include traditional directory services, financial information, news services, travel information, real estate listings, and other consumer goods services.

In addition, Singapore has invested in ISDN (Integrated Services Digital Networks), the integrated voice and data network standard that is one of the paths the superhighway might take toward multimedia delivery of information.

Whether the applications are stand-alone, or single network applications of international systems that allow video connections and touch-screen control, depends on the advancement and merging of parallel technologies.

But advancements in computer technology that make touch-screen and video-camera systems affordable, compatible, and available to the average consumer must also take place. While these technologies are available today in laboratories and certain high-end markets, it is difficult to say when they will be a reality for everyone.

Summary

The session covered the following topics:

- What is the information superhighway ?
- The Components
- Applications
- Some examples

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Mr. Watson, come here, I want you

Alexander Graham Bell

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Chapter 2

Going Digital

The topics covered in this session are

- *The digital world*
- *Building the highway*
- *Going On-line*
- *Navigating*
- *The Services*
  - *Video-on-demand*
  - *Interactive TV*
- *Internet*

In the previous session we learnt about the applications of the information superhighway. In this session we will take a look at the components of the information superhighway. We will also discuss the Internet - the prototype of the information superhighway.

As we have seen in the previous chapter, much of the underlying communications technology that is to be used as building material for the information superhighway is not new. And the race is on to improve what we already have.

From the analog telephone and cable television service to high-speed, digital, fiber-optic cable connections, the race is on to increase bandwidth. Bandwidth is the ability of a transmission medium (a cable) to carry signals - pictures, data, audio etc. The higher the bandwidth, the faster and greater the amount of data that you can transmit, and of course, the better connected you are.

2.1 The Digital World

Radio, television, and telephone systems use analog signals to carry picture and sound information. An analog signal is a signal whose frequency and/or intensity is directly proportional - analogous - to the data that the signal represents. The problem is that analog signals are difficult to record and transmit intact. Small amounts of noise and distortion are introduced into the signal at each step of the way. Once an analog signal is damaged by noise and distortion, there's no way to restore it.

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Digital systems communicate by breaking down data to a simple "on" or "off" condition. Digital transmission systems have in-built error correction. If the data is damaged between two points, the system automatically re-transmits the damaged data. Some digital systems also use a technique called forward error correction. This technique encodes the data so that if a few bits of data are lost in transmission, they can be reconstructed at the receiving end.

Devices called A/D converters and D/A converters handle the dual tasks of analog-to-digital and digital-to-analog conversion.

Fill in the blanks:

1. Digital systems communicate by breaking down data to a simple _____ condition.
2. An _____ handles the task of analog-to-digital conversion.

Answers

1. "on" and "off" condition
2. A/D converters

2.2 Building the highway

With the information superhighway promising to be an all-digital world, the race is on to adapt current technology to suit these requirements.

- **Telephone**

The human voice covers a range of about 300 to 2,000 cycles per second that is, 2,000 hertz(Hz), or 2 kilohertz (KHz). Sounds below 300Hz and above 2,000Hz are discarded by the telephone network. This limited bandwidth allows for telephone circuits to be made of inexpensive, small-gauge wire.

Traditionally all telephone communication is analog. With the advent of fiber-optics and digital technology, digital communication is also being used today. However, the advancement has been mainly in the switching and routing of calls and in the reliability of the world-wide telephone network. Even in the West and advanced countries, digital communication is mainly used to connect exchanges. The connection from the exchange to the office or home is still an analog voice signal travelling over a pair of small-gauge copper wires.

The telephone wire is what connects you to the digital network. With the use of a modem you can connect your PC to the telephone line. Computers are digital devices that communicate in "on" (1) and "off" (0)

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states. Telephone lines are designed to carry voice signals and therefore cannot transport digital data. The modem converts the computer's binary zeros and ones into varying tones that can be sent over ordinary telephone lines. The modem at the other end converts the tones back into binary zeros and ones.

Telephone lines carry one conversation at a time. So, if you want to use your modem or receive a fax and talk on the phone at the same time, you'll need two lines.

- **Television**

Cable television systems allow for carrying large quantities of data However there is no way to put a signal back onto the cable system's wire.

Each telephone subscriber has a discrete pair of wires that connect the subscriber to the central switching office. Cable systems on the other hand, don't need to have a separate wire for each subscriber. The cable coming into your home has exactly the same electronic signals on it as the cable going into a friend's home, and all other homes in the neighbourhood.

Cable TV systems are also analog networks. The signal on the TV cable is the same type of analog signal transmitted by over-the-air TV stations.

Inside a digital TV

An HDTV (High Definition Television) digital television is part TV set, part computer. Like a conventional TV set, an HDTV set receives radio-frequency signals from an antenna or cable system. A tuner circuit allows the user to select the desired channel, and a demodulator circuit converts the received radio signal into a stream of digital data.

The received data is processed by a microprocessor. The microprocessor manages the flow of data among the other parts of the set.

One of the critical components of an HDTV set is the compression chip. HDTV transmissions are compressed using the MPEG (Motion Picture Experts Group) data compression standard. A dedicated MPEG

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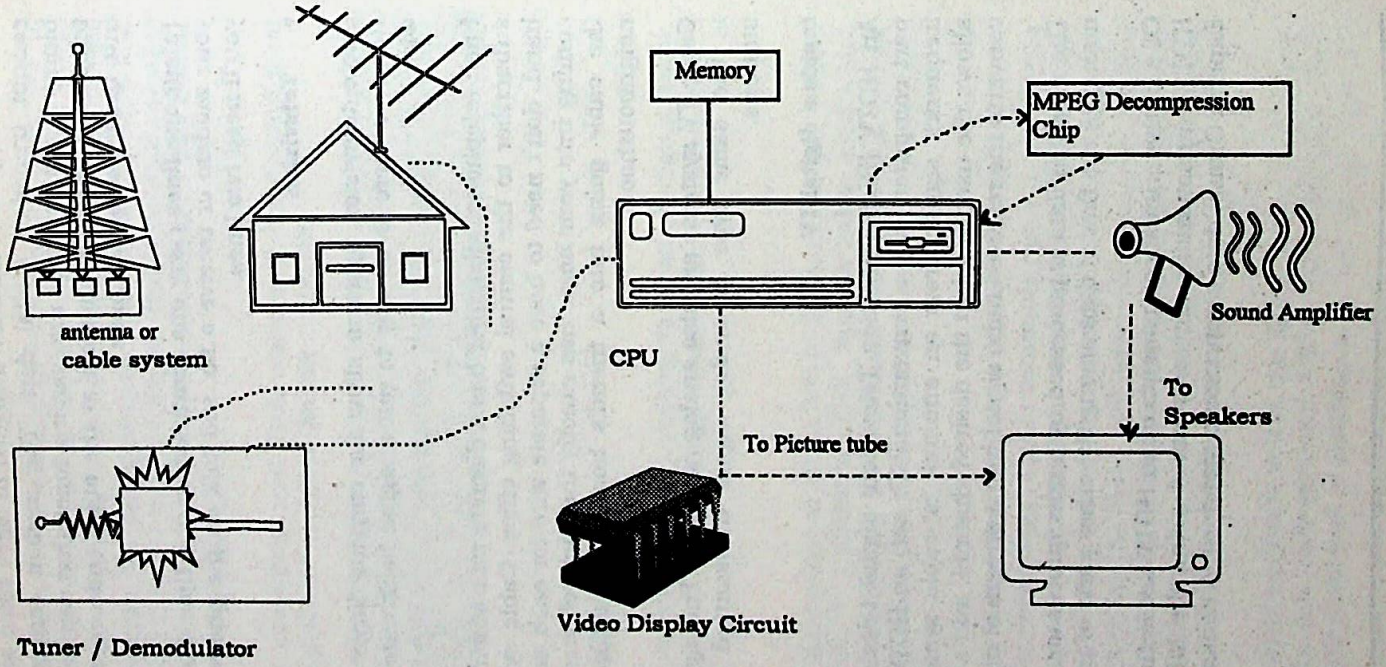

Fig. 2.1 Inside a digital TV

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decompression chip handles the chore of expanding the compressed data back to its original form.

A digital-to-analog converter takes audio data from the CPU and converts the data into six channels of high-quality audio. The six channels allow for stereo surround-sound or multilingual applications.

The CPU sends the expanded picture data to a video display circuit, much like the video display found in PCs. The video display circuit takes the picture data and compresses it into a displayable image.

Looking into the future

If you were to imagine a present-day high-tech home, a phone, fax machine, and PC modem are connected to the telephone line. All voice and data communications take place over this line.

Programs produced by the television networks are transmitted to a communication satellite, which relays the signal back down to Earth.

Local cable TV operators receive a variety of programs from dozens of sources, mostly via satellite and then transmit it to your home through a cable.

The goal of the information superhighway is to combine the bandwidth of the cable network with the switching flexibility of the telephone network. The resulting two-way, high-bandwidth network will allow users to send and receive video, voice, and computer data, all on the same wire at the same time.

So now let us stretch this theory and imagine what life on the information superhighway holds for us.

In an all-digital world the phone, PC, and television will be connected in a different way. In place of separate cable TV and telephone connections, you'll have a single digital link to the information highway.

All data entering and leaving your home or office passes through the premise distribution equipment (PDE), which is a small computer. The PDE separates the digital signals going to your PC, television, and telephone. Future-generation TVs and PCs will likely have the PDE circuitry built-in.

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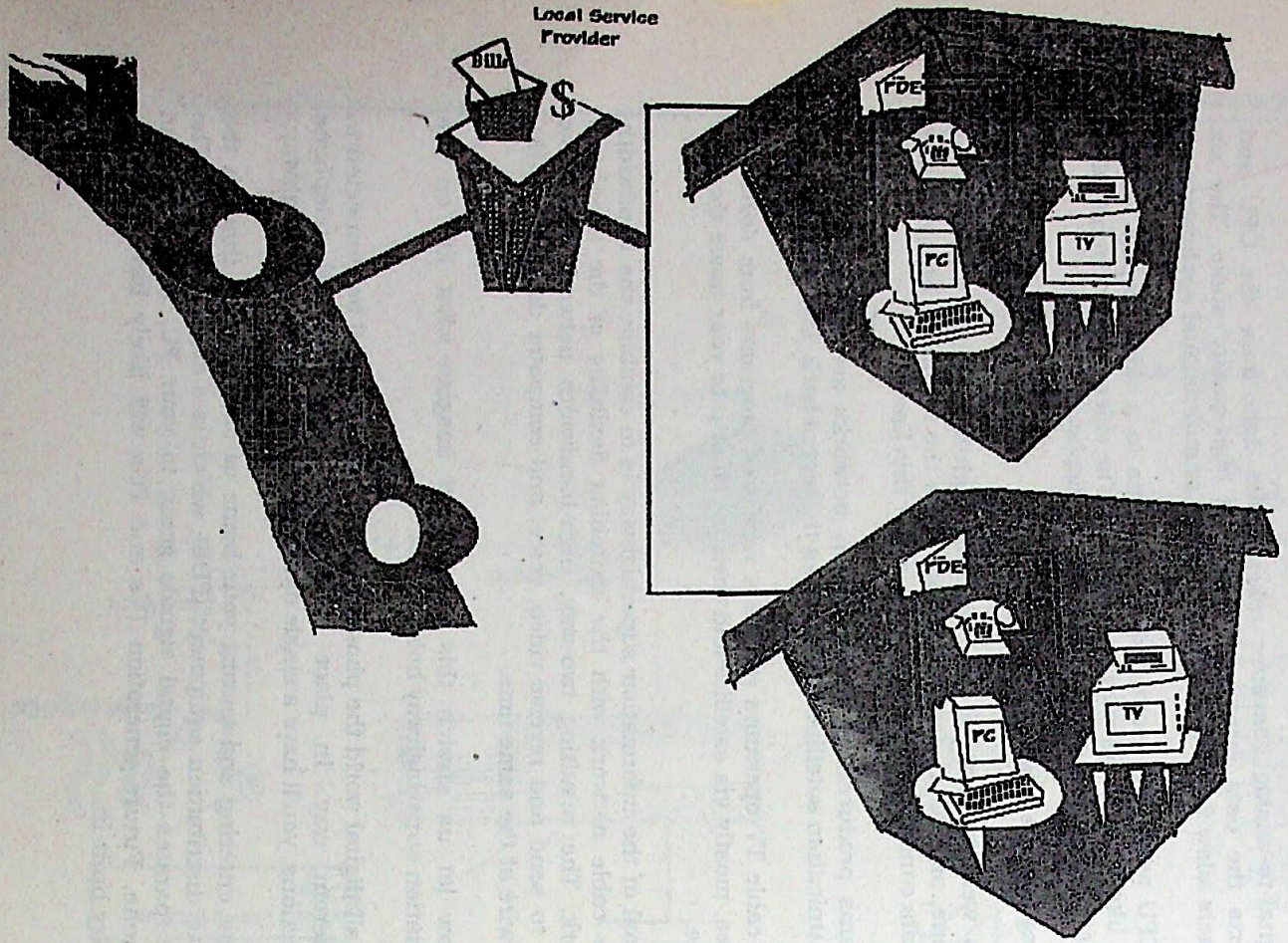

Fig. 2.2 How the digital highway will work

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The VCR may be another computer. It can store the digital data received from the network and can be used to record messages, video clips, or even a personalised video newspaper tailored to your needs.

In place of the phone company and cable TV company, there will be a generic *local service provider*. The service provider will act as your tollbooth onto the information superhighway, controlling and billing your access to the services available on the network.

A new type of video-on-demand will allow you to retrieve any movie, news broadcast, or other TV program at any time.

Where now you get separate bills for the telephone and cable TV services that you use, in the future you will receive a single bill from the local service provider. The local service provider, who may be the local cable TV provider will be your ramp or connection onto the information superhighway.

2.3 Going on-line

But how will you get on and off the information superhighway?

A set-top box will be required to convert signals from digital to analog. Incoming digital video can be converted to a format that existing TV's and VCR's can use. Apart from processing incoming data and performing conversion tasks, it must be sophisticated enough to allow data entry, thus providing the all-important element of interactivity. The digital interface connection should allow you to connect your PC to the set-top box allowing you to connect to the digital network.

The components of the box may vary according to each maker, but there are some common elements. These being a high-powered CPU chip and plenty of RAM, similar to those found in desktop computers. The program code is stored in RAM. If the set-top box needs a software update, it can be downloaded directly to your box over the network.

The set-top box will thus be the interface between the information superhighway, which is all digital, and an otherwise analog world.

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2.4 Navigating

There will a unique technology that enables you to interact as you wish with the networks and services of the superhighway. This technology is being built into what computer and communications companies call "the navigator".

The navigator is software that runs on the teleputer or enhanced television to guide the user quickly and easily around the program choices and different networks on the information highway. It's the steering wheel of the various vehicles of entertainment, education, and information available on the highway.

The information superhighway navigator will allow program choice, provide the ability to manipulate the program, and will create a system that will let you intuitively access programs without being aware of the steering wheel.

Interactivity will be a mainstay of the navigator and the programs it allows access to. Users will be able to call forth whatever type of program they choose and actively participate in it by talking, typing, or touching the screen.

2.5 The Services

Of the many proposed services to be offered on the information superhighway, the most talked about ones are Video-on-demand and Interactive TV. So let us understand what exactly these services mean.

- **Video-on-demand**

Video-on-demand or VoD is digital entertainment technology at its best. Movies on celluloid or video tape are digitised and stored in computers and can be called up at will. A device called a video server is required for program retrieval.

A video server connects to a digital network, and provides digital video and sound to users on the network. The program material resides on the server in digital form - as files on a hard disk, optical disk, or digital tape.

In essence a video server is a specialised file server. When a user requests a particular program, the server retrieves a file containing the digital image and sound, and sends the data out over the network. Like

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a file server, several users can retrieve files at the same time. Several users can even retrieve the same file at the same time.

Your set-top box sends a request to the video-on-demand service. The service retrieves the program from its storage bank and transmits the data back to your set-top box. The set-top box converts the digital data into analog video for viewing on your screen.

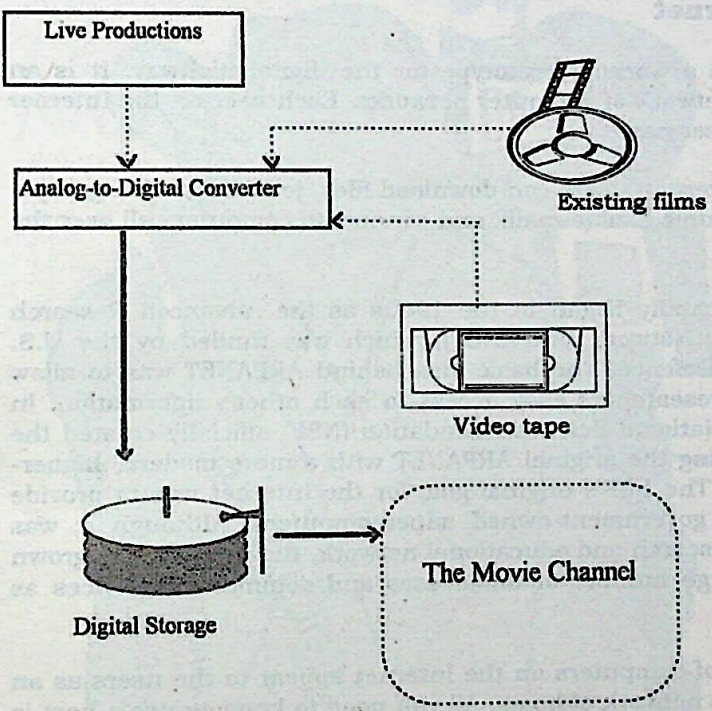

Fig. 2.3 Video-on-demand

All you do is use the remote control to punch in a few commands and you movies, cartoons, favourite chat shows, educational videos, and a lot more, available on demand. You don't have to wait for the movie to start, you can pause where you want, and most important you don't have to go out to the video cassette shop.

- **Interactive Television**

Interactive television works on the principle of a two-way conduit to create an interaction between broadcaster and viewer, or among many

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viewers. The information superhighway is meant to be a two-way communication medium.

Let us look at an example. If perhaps you are taking a tele-education course in computer awareness, and you had a query on the "Internet", you could dial in to the instructor to receive more information on the topic.

2.6 The Internet

The Internet is a working prototype for the digital highway. It is an international network of computer networks. Each user on the Internet has a unique user name.

Through the Internet, users can download files, join discussion groups, exchange electronic mail (e-mail), and connect to computers all over the world.

The Internet actually began in the 1960s as the Advanced Research Projects Agency Network (ARPANET), which was funded by the U.S. Department of Defence. The basic idea behind ARPANET was to allow scientists and researchers easy access to each other's information. In the 1980s the National Science Foundation (NSF) officially created the Internet, replacing the original ARPANET with a more modern, higher-speed network. The NSF's original goal for the Internet was to provide access to four government-owned supercomputers. Although it was intended as a research and educational network, the Internet has grown to include a large number of businesses and commercial services as well.

The thousands of computers on the Internet appear to the users as an almost seamless network of hosts. All you need to know to use a host is its name, and all you need to know to send e-mail to someone is that person's user name.

In addition to the name, each host has a three letter suffix to indicate the nature of the organisation operating the host. For example, commercial services use the suffix .com, .edu (educational institutions).

Using a facility called **Telnet**, any individual user on the Internet can connect to any computer on the Internet. Once connected to a host, a user can run programs on the host as if he or she were sitting at a terminal directly connected to the host system. Telnet is a very powerful

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Fig. 2.4 The Internet

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tool, and it is one of the main communication tools used on the Internet.

The **File Transfer Protocol** (FTP) is another useful Internet function. Internet users can take advantage of FTP to copy files from a host system to their own computer. There are millions of files available on the Internet, and any user has access to them. In fact there are so many hosts containing so many files that some hosts are dedicated to the task of helping users sift through that information. Special hosts called Archie servers keep track of all the files that are publicly posted on the Internet.

In addition to e-mail, the Internet is host to a global conferencing system called **Usenet**. Usenet is essentially an open forum conducted via e-mail. There are thousands of Usenet topics, and new topics are added almost daily.

Summary

In this session the following topics were covered:

- The digital world
- Building the highway
- Going On-line
- Navigating
- The Services
    - Video-on-demand
    - Interactive TV
- Internet

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Glossary

Address

The way a particular location in computer memorry is referenced

Algorithm

A set of rules or defdined process which performs a particular task

Alphanumeric

A group of characters which includess a mix of numerals, alphaberic letters and (sometimes) punctuation marks and othersymbols

Analog signal

A smoothly varying value of voltage or current, ie a signbal that varies continuously in amplitude and time. It often represents a measured physical quantity.

ARPANET

The network created by the U.S. Department of Defense Advancd Research Project Agency from which the present Internet evolved. The original ARPANET was retired in 1990.

ASCII

American Standard Code for Information Interchange. A file format developed by the American National Standards Institute that defines plain text files.

Attribute

Describes an entity

Bandwidth

Measurement of the information transmission capacity of a telecommunications link.

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Baud rate

The number of times per second that a system, especially a data transmission channel, changes state.

Bus

A collection of parallel signal lines through which data or messages can be transferred from one place to another in a circuit.

Coaxial cable

A copper or aluminium wire that is wrapped in one or more layers of insullating metallic and/or fibrous sheathing, and that protects the data carrying wire from external electrical static and noise.

CRCC

Cyclic Redundancy Check Character

Data Definition language

A languagee used to specify data structires and relatiuonships

Data Dictionaries

Inportant component of a database management system which contains data definitions and other information to help control, monitor and protect the database

Data manipulation language

A language used to store, rretrieve and update items in a database

Database

Computerised information organised to make its storing, updating ad retrieval efficient and reliable

Database administrator

Job function responsible for eestablishing, deeveloping and controlling the database

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DBMS

The design and software echniques used to organise the database structure and provide acess to information in it

Direct Memory Access (DMA) channel

A dedicated microprocessor that transfeers data from memory to memory without using the CPU. Data is transferred at a faster rate

Display Adapter Card

A card used to interface with the Visual Display Unit.

Dynamic Link Library

A file conmtaining executable code and data bound to a program at load time or run time, rather than during linking. The code and data can be shared by several applications simultaneously

Digital signal

A waveform or signal whose voltage at any particular time will be at any one group of discrete levels, generally two; a two-level signal is sometimes called a binary digital signal or binary signal. In binary logic circuits, in which only two discrete voltage levels are used, one level will correspond to logic 1 (true), usually the high-level, and the other will correspond to logic 0 (false).

E-mail

Electronic mail. A term to describe the transmission of messages by the use of computing systems and telecommunications facilities.

Fiber-optic cable

A data transmission medium made of tiny threads of glass that is able to transmit hug amounts of information at the speed of light.

File

Information organised into an interrelated set of records

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File Transfer Protocol

The standard method for moving files on the Internet. Ftp uses a client/server architecture where users can get (download) files or put (upload) files.

Host computer

A main control computer in a network of distributed processors and terminals.

Hertz

Unit of measurement of transmission signal frequency (cycles per second)

Hierarchical data structures

Data units are structured in multiple levels. There is a superior-subordinate relationship in this structure

Internet

Term used to refer to a TCP/IP network that is typically constructed using individual physical networks that are interconnected using routers and possibly wide area network data links.

Matrix

A table consisting of Rows and Columns.

Microprocessor

A CPU on a chip; a device that provides the basic arithmetic, logic, and control circuits required for processing.

Modem

A device that modulates and demodulates signals transmitted over voice-grade communication facilities.

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Network

The interlinnking of many computers, terminals and other devices by telecommunications links according to a structured architecture and agreed protocols for communication.

RAM

Main memory on a chip which allows the user to read from and write to it, so that programs and data in it can be changed.

Resolution

The number of pixels that can be displayed on a screen.

Schemas

The formal description of the data structuring in a database

SCSI

Small Computer System Interface. A single interface card in a single PC slot onto which a number of external SCSI devies can be connected (daisy chained) together

Subschemas

A grouping of data elements defined in a schema

Twisted-pair wire

A pair of insulated, copper wires twisteed into a single, wrapped set. Twisted-pair wires form the basis of standard phone lines and are commonly also used for data communications.

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APTECH
COMPUTER EDUCATION

SYS/95/07/50
C-95/Sem-II/05-95

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